SECURITY INFORMATION

CONFIDENTIAL

Copy 5
RM E51L12

JUN 3 1953

REVISED VERSION

NACA RM E51L12

UNCLASSIFIED

RESEARCH MEMORANDUM

ALTITUDE WIND TUNNEL INVESTIGATION OF XJ34-WE-32 ENGINE PERFORMANCE WITHOUT ELECTRONIC CONTROL

By Harry E. Bloomer, William J. Walker
and George L. Pantages

Lewis Flight Propulsion Laboratory
Cleveland, Ohio

CLASSIFICATION CHANGED

To UNCLASSIFIED

By authority of TPA #29 Date 8/17/60 JW

FOR REFERENCE

NOT TO BE TAKEN FROM THIS ROOM

CLASSIFIED DOCUMENT

This material contains information affecting the National Defense of the United States within the meaning of the espionage laws, Title 18, U.S.C., Secs. 793 and 794, the transmission or revelation of which in any manner to an unauthorized person is prohibited by law.

NATIONAL ADVISORY COMMITTEE
FOR AERONAUTICS

WASHINGTON
May 29, 1953

N A C A LIBRARY
LANGLEY AERONAUTICAL LABORATORY
Langley Field, Va.

CONFIDENTIAL

UNCLASSIFIED

NASA Technical Library
3 1176 01434 9816

UNCLASSIFIED

NATIONAL ADVISORY COMMITTEE FOR AERONAUTICS

RESEARCH MEMORANDUM

ALTITUDE WIND TUNNEL INVESTIGATION OF XJ34-WE-32 ENGINE PERFORMANCE WITHOUT ELECTRONIC CONTROL

By Harry E. Bloomer, William J. Walker
and George L. Pantages

2470

SUMMARY

An investigation was conducted in the NACA Lewis altitude wind tunnel to evaluate the performance characteristics of an XJ34-WE-32 turbojet engine which was equipped with an afterburner, a variable-area exhaust nozzle, and an integrated electronic control. The data were obtained with the afterburner and electronic control inoperative. Performance data were obtained at altitudes from 5000 to 55,000 feet and flight Mach numbers from 0.28 to 1.06 for a complete range of operable engine speeds at each of four fixed positions of the variable-area exhaust nozzle.

The variation of generalized values of jet thrust, net thrust, and air flow with corrected engine speed were adequately defined by a single curve for altitudes up to 40,000 feet at a flight Mach number of 0.528. Generalized values of fuel flow and performance variables dependent upon fuel flow varied with changes in altitude at a given flight Mach number. Engine pumping characteristics, from which engine performance can be predicted for corrected engine speeds of 11,500 and 12,500 rpm over a wide range of Reynolds number index are presented, and two methods of thrust modulation from 70 to 100 percent of maximum thrust are compared. The results indicate that the specific fuel consumption was essentially the same for thrust modulation obtained by varying engine speed at constant exhaust-nozzle area and by varying exhaust-nozzle area at constant engine speed.

INTRODUCTION

As a part of the comprehensive investigation of the XJ34-WE-32 engine conducted in the NACA Lewis altitude wind tunnel, the over-all performance was determined over a range of altitudes and flight Mach numbers. Other phases of the investigation are reported in reference 1.

The performance data presented herein were obtained at four fixed settings of the variable-area exhaust nozzle and with the afterburner

CONFIDENTIAL

UNCLASSIFIED

and electronic control inoperative. Data were obtained at altitudes from 5000 to 55,000 feet and flight Mach numbers from 0.28 to 1.06. The results are given in tables and also in graphical form to show the trends of engine performance associated with changes of altitude, flight Mach number, and exhaust-nozzle area.

APPARATUS AND PROCEDURE

Engine

2470

The XJ34-WE-32 engine, with afterburner inoperative, has a static sea-level thrust rating of 3370 pounds at an engine speed of 12,500 rpm and an average turbine-inlet temperature of 1525° F. At this operating condition, the air flow is approximately 58 pounds per second. The engine has an 11-stage axial-flow compressor, a double annular combustor, a two-stage turbine, and an integral afterburner. The over-all length of the engine is 185 inches and the maximum diameter is 27 inches at the afterburner. The total weight of the engine and accessories is 1558 pounds. The engine is equipped with an electronic control which provides thrust regulation throughout the unaugumented and afterburning regions by means of a single thrust-selector lever. A mixer-vane assembly was installed at the compressor discharge because of a temperature-inversion problem at the turbine.

Installation

The engine and afterburner were mounted on a wing section that spanned the 20-foot-diameter test section of the altitude wind tunnel (fig. 1). Dry refrigerated air was supplied to the engine from the tunnel make-up air system through a duct connected to the engine inlet. Throttle valves were installed in the duct to permit regulation of the pressure at the inlet of the engine. Engine thrust and drag measurements by the tunnel balance scales were made possible by the frictionless slip joint located in the duct upstream of the engine.

Instrumentation for measuring pressures and temperatures was installed at various stations in the engine (fig. 2).

Procedure

Pertinent engine-performance data were obtained over the range of flight conditions listed in the following table:

Altitude (ft)	Flight Mach number			
	0.28	0.53	0.79	1.06
5,000	x			
10,000		x		
25,000	x	x	x	x
40,000		x	x	x
47,000		x		
55,000		x	x	

2470

At most of the flight conditions listed, data were obtained over a wide range of engine speeds at the full open, full closed, and at two intermediate exhaust-nozzle areas corresponding to projected nozzle areas of 153, 164, 192, and 274 square inches. Data were not obtained, however, when the combination of nozzle area and engine operating conditions was such that excessive turbine temperatures resulted.

In order to set up these various flight conditions, the air flow through the make-up air duct was throttled from approximately sea-level pressure to the total pressure that corresponded to the desired flight Mach number at a given altitude. The tunnel, into which the engine exhausted, was set at the desired altitude ambient pressure. In the calculation of flight Mach number, complete ram-pressure recovery was assumed. The temperature of the inlet air approximated NACA standard values except that the minimum temperature obtained was 440° R. The fuel used was MIL-F-5572, grade 80 (ANF-48b), clear gasoline, having a lower heating value of 19,000 Btu per pound and a hydrogen-carbon ratio of 0.186.

The methods of calculation and the symbols used herein are given in the appendix.

RESULTS AND DISCUSSION

Values of the variables which are descriptive of engine performance are tabulated in table I along with the engine-operating and simulated-flight conditions.

During the investigation, the engine was sometimes operated at compressor pressure ratios that caused the compressor to operate in a mild-stall condition. Because of this phenomenon, the engine performance variables are affected and apparent discontinuities appear in the data. In general, this stall operation occurred in the engine-speed range from 10,000 to 12,500 rpm at altitudes from 25,000 to 55,000 feet

and, of course, was most prevalent with the smaller exhaust-nozzle areas. The specific conditions at which stall influenced the performance are given in the following table:

Altitude (ft)	Flight Mach number	Engine-speed range (rpm)	Exhaust-nozzle projected area (sq in.)
25,000	0.28	10,000 - 11,000	153
25,000	.53	11,500 - 11,750	153
40,000	.53	10,000 - 12,500	153
40,000	.79	10,500 - 11,500	153
40,000	1.06	11,400 - 11,500	153
47,000	.53	Below 11,000	164
55,000	.53	All points taken	192
55,000	.79	Below 11,500	192

2470

The use of an electronic control which schedules open exhaust nozzle until rated engine speed is attained would permit the engine to skirt all stall regions encountered during the investigation.

Generalized Performance

Engine-performance data have been generalized to NACA standard sea-level conditions by use of the conventional factors δ_T and θ_T, which are defined in the appendix. Generalized performance variables for all flight conditions investigated are given in table I. The effectiveness of the correction factors in correlating data obtained at various flight conditions to a single curve is shown in figures 3 to 9. Changes in component efficiencies such as those associated with variations in Reynolds number which accompany changes in altitude or flight speed will, of course, lessen the possibility of defining generalized performance by a single curve.

Effect of altitude. - The corrected performance data, obtained at a flight Mach number of 0.528 and at altitudes from 10,000 to 55,000 feet, are presented in figures 3 to 8 to show the effect of altitude on the corrected engine performance variables when the variable-area exhaust nozzle is in each of four fixed positions. The corrected values of jet thrust (fig. 3) and net thrust (fig. 4) reduce to a single curve for altitudes from 10,000 to 40,000 feet for all exhaust-nozzle sizes. A further increase in altitude resulted in higher values of the corrected thrusts. This increase in thrust is traceable to the reduction in compressor efficiency with altitude which requires a higher turbine-inlet temperature to sustain a given corrected engine speed. Inasmuch as compressor pressure ratio is a function of the turbine-inlet temperature, the thrust is increased notwithstanding the slight decrease in air flow shown in figure 5. Corrected values of air flow reduced to a single curve for all altitudes up to 40,000 feet for the variable-area exhaust nozzle in the wide-open position. For the two intermediate

positions of the nozzle, the air flow reduced to a single curve only for altitudes up to 25,000 feet. Any further increase in altitude reduced the air flow throughout the engine-speed range. For the smallest exhaust-nozzle area, however, the generalized air flow reduced to a single curve, within the range of data scatter, for altitudes from 10,000 to 40,000 feet, the highest altitude investigated. The aforementioned reductions in air flow with increasing altitude are probably due to changes in the internal-flow conditions caused by lower Reynolds numbers at the higher altitudes.

2470

Because of large changes in combustion efficiency with altitude, the parameters that are dependent upon fuel flow did not reduce to a single curve for any engine speed or altitude at which data were taken. Corrected fuel flow (fig. 6) and corrected specific fuel consumption (fig. 7) increased with altitude throughout the range of corrected engine speeds. These trends are the result of lower engine combustion efficiencies caused by low pressures in the combustor at higher altitudes.

Corrected exhaust-gas total temperature (fig. 8) also increased with altitude throughout the corrected engine-speed range. This trend is due to reductions in compressor and turbine efficiencies with altitude that require higher temperatures to maintain a given corrected engine speed.

Effect of flight Mach number. - With the exception of corrected air flow, a single-curve correlation of generalized performance variables obtained over a range of flight Mach numbers is precluded by variations in engine pressure ratio, combustion efficiency, and Reynolds number effects on component efficiencies. The effect of flight Mach number on the variation of corrected air flow with corrected engine speed is presented in figure 9 for an altitude of 25,000 feet. Data showing the effect of flight Mach number on other performance variables are included in table I. Corrected air flow reduced to a single curve at the higher engine speeds and diverged slightly at the lower engine speeds for the three largest exhaust-nozzle areas. The greater separation of the corrected air-flow curves for the small nozzle area probably is the result of localized regions of stall within the compressor that result from the proximity of the engine operating lines to the compressor stall line. This trend of reduced air flow during stall is evidenced by the two data points obtained in the stall region.

From the data of figures 3 to 8, performance within the range of the investigation can be determined for operation at a flight Mach number of 0.528. In order to permit calculation of engine performance at other flight Mach numbers, engine performance is presented in terms of pumping characteristics, which are discussed in the following section.

Pumping Characteristics

Engine performance is presented in figures 10 to 12 in terms of engine total-pressure ratio, engine total-temperature ratio, corrected air flow, corrected fuel flow, and Reynolds number index for corrected engine speeds of 12,500 and 11,500 rpm. (The relation between Reynolds number index, altitude, and flight Mach number is shown in fig. 13.) From the data presented, complete engine performance may be computed at any flight condition within the range of Reynolds number indices covered by these data provided that losses in the tail pipe and the exhaust nozzle are known.

The data presented in figure 10 indicate that the critical Reynolds number index was about 0.60 at the temperature ratios and the corrected engine speeds investigated. As the Reynolds number index was reduced below the critical, the engine pressure ratio decreased rapidly. This reduction in engine pressure ratio is associated with the reduction in component efficiencies at low Reynolds numbers. This same trend is evident for corrected air flow (fig. 11). The reduction in air flow, however, is probably due to a reduction in effective-flow area caused by an increasing boundary-layer thickness or flow separation in the compressor passages. Air flow for different temperature ratios reduced to a single curve at a constant corrected engine speed of 12,500 rpm because of choking in the first stage of the compressor. However, the air flows for different temperature ratios at a constant corrected engine speed of 11,500 rpm, where the compressor is not choked, do not reduce to a single curve.

As a matter of convenience, the corrected fuel flow is presented as a function of Reynolds number index in figure 12. Although Reynolds number index is not intended to be a basis for generalizing combustion data, the correlation obtained is adequate for presentation of the fuel-flow results. The rapid increase in fuel flow at the low Reynolds number indices is obviously a result of low combustion efficiency which is associated with high altitude flight conditions. From these curves, air flow, fuel flow, and total pressure can be determined at the turbine outlet for any flight condition within the range of Reynolds number indices covered. With these values and an average over-all tail-pipe pressure loss, of 0.065 of the turbine-outlet total pressure as determined in this investigation, jet thrust can be calculated by using equation (7) in the appendix. The over-all engine performance for other tail-pipe or inlet-duct configurations may also be readily obtained if the pressure-loss characteristics of these configurations are known. This method may be extended to the lower engine-speed range by construction of similar plots from the data in table I.

Effect of Method of Engine Operation on Performance

The engine performance variables in ungeneralized form are presented in figures 14 to 17. These data have been adjusted to compensate for experimental deviation from standard NACA inlet temperature and pressure conditions by the use of the factors δ_{adj} and θ_{adj} defined in the appendix.

2470 The variation of net thrust and specific fuel consumption with turbine-outlet temperature for altitudes of 10,000 and 25,000 feet at a Mach number of 0.528, shown in figure 14, demonstrates conditions of engine speed and turbine-outlet temperature for maximum thrust and minimum specific fuel consumption. The value and location of the maximum engine speed for each operating line is indicated. Maximum thrust occurs at maximum engine speed and limiting turbine-outlet temperature for any given nozzle size. At this maximum thrust condition, the specific fuel consumption was slightly higher than the minimum value obtainable. It should be noted that with the smallest exhaust-nozzle size, rated engine speed cannot be reached at either altitude because of turbine temperature limitations. Rated engine speed is reached before the turbine temperature limit when the three larger nozzle sizes are used. Also it should be noted that, whereas the slope of the thrust curve is always positive, thus indicating larger thrusts for higher temperatures, the specific fuel consumption curve reaches a minimum value before the limiting temperature is reached. Therefore, there exists for each flight condition a different engine speed and exhaust-nozzle area at which minimum specific fuel consumption (at reduced thrust) may be obtained. These points are discussed in more detail in the following paragraphs.

The variation of net thrust with altitude at a constant flight Mach number of 0.528 is shown in figure 15(a). The data show performance results at rated engine speed with thrust variations obtained by changes in exhaust-nozzle area. The circular symbols represent maximum thrust points at rated engine speed and maximum turbine temperature limit. These data were taken from cross-plots of data similar to that shown in figure 14. The other symbols represent points at 90, 80, and 70 percent of the maximum thrusts; these thrusts and the accompanying specific fuel consumptions, presented in figure 15(b), were interpolated at rated speed and larger exhaust-nozzle areas. The specific fuel consumption did not change significantly with the thrust level.

Another way of modulating thrust is by keeping a constant exhaust-nozzle size and changing engine speed. Figure 15(c) shows the engine speeds required to produce 90, 80, and 70 percent of maximum thrust with a fixed exhaust-nozzle area of 164 square inches. Figure 15(d) shows the variation with altitude of specific fuel consumption for

constant exhaust-nozzle area operation at these engine speeds. Again, as thrust is reduced to as little as 70 percent of maximum thrust by lowering engine speed, the specific fuel consumption remains practically constant for the given altitudes. Comparing this mode of operation with the method of constant engine speed and varying nozzle area fail to disclose any significant difference in specific fuel consumption within this thrust range. 2470

The effect of flight Mach number at 25,000 feet, with the same variables presented in figure 15, is presented in figure 16. Again, for the various flight Mach numbers shown, there is little difference in performance for the two methods of thrust modulation at any flight Mach number.

CONCLUDING REMARKS

Complete engine-performance data were obtained for operation over a wide range of engine speeds and with four fixed exhaust-nozzle areas at simulated altitudes as high as 55,000 feet and flight Mach numbers as high as 1.06. Results obtained at a flight Mach number of 0.528 for altitudes from 10,000 to 55,000 feet were generalized by the use of the correction factors δ_T and θ_T. Jet thrust, net thrust, and air flow in general reduced to a single curve as a function of corrected engine speed for a given flight Mach number and altitudes up to about 40,000 feet; however, parameters involving fuel flow failed to reduce to a single curve. For operation over a range of flight Mach numbers from 0.284 to 1.055 at a constant altitude of 25,000 feet, only corrected air-flow values tended to reduce to a single curve. Engine performance at speeds of 11,500 and 12,500 rpm may readily be calculated, however, for a range of either flight Mach numbers or altitudes by the use of engine pumping curves presented herein. All the data obtained are also given in tabular form thereby permitting the construction of pumping-characteristic curves for a wide range of engine speeds.

Two methods of thrust modulation, (a) varying engine speed at constant exhaust-nozzle area and (b) varying exhaust-nozzle area at constant (rated) engine speed, were compared. For thrust loads from maximum to 70 percent of maximum at a given flight condition, the specific fuel consumption was essentially independent of the mode of operation over the entire range of flight conditions simulated.

Lewis Flight Propulsion Laboratory
National Advisory Committee for Aeronautics
Cleveland, Ohio

[redacted]

2470

APPENDIX - CALCULATIONS

Symbols

The following symbols are used in the calculations and on the figures:

A	cross-sectional area, sq ft
B	thrust-scale reading, lb
C_V	velocity coefficient, ratio of scale jet thrust to rake jet thrust
D	external drag of installation, lb
D_r	drag of exhaust-nozzle survey rake, lb
F_j	jet thrust, lb
F_n	net thrust, lb
g	acceleration due to gravity, 32.2 ft/sec^2
M	Mach number
N	engine speed, rpm
P	total pressure, lb/sq ft absolute
p	static pressure, lb/sq ft absolute
R	gas constant, 53.4 ft-lb/(lb)($^{\circ}$R)
T	total temperature, $^{\circ}$R
t	static temperature, $^{\circ}$R
V	velocity, ft/sec
W_a	air flow, lb/sec
W_f	fuel flow, lb/hr
W_g	gas flow, lb/sec
γ	ratio of specific heat for gases

δ_T ratio of compressor-inlet absolute total pressure to absolute static pressure of NACA standard atmosphere at sea level

δ_{adj} ratio of compressor-inlet absolute total pressure to total pressure of NACA standard atmosphere at altitude flight condition

θ_T ratio of compressor-inlet absolute total temperature to absolute static temperature of NACA standard atmosphere at sea level 2470

θ_{adj} ratio of compressor-inlet absolute total temperature to total temperature of NACA standard atmosphere at altitude flight condition

ϕ ratio of kinematic viscosity of air at compressor inlet to viscosity of NACA standard atmosphere at sea level

Subscripts:

a air

f fuel

i indicated

s scale

0 free-stream conditions

1 inlet duct at frictionless slip joint

2 compressor-inlet annulus

5 turbine outlet

7 exhaust-nozzle inlet

8 exhaust nozzle, $1\frac{3}{8}$-in. forward of fixed portion of exhaust nozzle

Methods of Calculation

Flight Mach number. - The flight Mach number, assuming complete ram-pressure recovery, was calculated from the expression

2470

$$M_0 = \sqrt{\frac{2}{\gamma_1 - 1}\left[\left(\frac{P_1}{p_0}\right)^{\frac{\gamma_1 - 1}{\gamma_1}} - 1\right]} \qquad (1)$$

Airspeed. - The following equation was used to calculate the equivalent airspeed

$$V_0 = M_0 \sqrt{\gamma g R T_1 \left(\frac{p_0}{P_1}\right)^{\frac{\gamma_1 - 1}{\gamma_1}}} \qquad (2)$$

Temperature. - Static temperatures were determined from indicated temperatures with the following relation

$$t = \frac{T_i}{1 + 0.85\left[\left(\frac{P}{p}\right)^{\frac{\gamma - 1}{\gamma}} - 1\right]} \qquad (3)$$

where 0.85 is the impact recovery factor for the type of thermocouple used. Total temperature was calculated from the adiabatic relation between temperatures and pressures.

Air flow. - Air flow was determined from pressure and temperature measurements in the engine-inlet air duct by use of the equation

$$W_{a,1} = p_1 A_1 \sqrt{\frac{2\gamma_1 g}{(\gamma_1 - 1) R t_1}\left[\left(\frac{P_1}{p_1}\right)^{\frac{\gamma_1 - 1}{\gamma_1}} - 1\right]} \qquad (4)$$

Gas flow. - The total weight flow through the engine was calculated as follows:

$$W_{g,5} = W_{a,1} + \frac{W_f}{3600} \qquad (5)$$

<u>Jet thrust</u>. - The jet thrust of the installation was determined from the balance-scale measurements by using the following equation:

$$F_{j,s} = B + D + D_r + \frac{W_{a,1}\ V_1}{g} + A_1\ (p_1 - p_0) \tag{6}$$

The last two terms of this expression represent the momentum and pressure forces on the installation at the slip joint in the inlet-air duct. The external drag of the installation was determined with the engine inoperative. Drag of the water-cooled exhaust-nozzle survey rake was measured by an air-balance piston mechanism.

Scale net thrust was obtained by subtracting the equivalent free-stream momentum of the inlet air from the scale jet thrust:

$$F_{n,s} = F_{j,s} - \frac{W_{a,1}\ V_0}{g}$$

<u>Jet thrust</u>. - If it is assumed that there is complete expansion and that there are no losses in the exhaust system,

$$F_j = \frac{W_a\left(1 + \frac{W_f}{W_a}\right)}{g} \sqrt{\frac{2\gamma_5 g R T_5}{(\gamma_5 - 1)}\left[1 - \left(\frac{p_0}{p_5}\right)^{\frac{\gamma_5 - 1}{\gamma_5}}\right]} \tag{7}$$

REFERENCES

1. Sobolewski, A. E., and Farley, J. M.: Steady-State Engine Windmilling and Engine Speed Decay Characteristics of an Axial-Flow Turbojet Engine. NACA RM E51I06, 1951.

2470

2470

TABLE I. - PERFORMANCE AT VARIOUS ENGINE-OPERATING AND

Run	Altitude (ft)	Ram pressure ratio $\frac{P_1}{p_0}$	Flight Mach number M_0	Tunnel static pressure p_0 $\left(\frac{lb}{sq\ ft\ abs.}\right)$	Reynolds number index $\frac{\delta_T}{\phi\sqrt{\theta_T}}$	Engine speed N (rpm)	Equivalent ambient air temperature t (°R)	Engine-inlet indicated temperature T_1 (°R)	Jet thrust, (lb) Altitude F_j	Jet thrust, (lb) Corrected $\frac{F_j}{\delta_T}$	Jet thrust, (lb) Adjusted $\frac{F_j}{\delta_{adj}}$	Engine total-pressure ratio $\frac{P_5}{P_2}$	Net thrust, (lb) Altitude F_n	Net thrust, (lb) Corrected $\frac{F_n}{\delta_T}$	Net thrust, (lb) Adjusted $\frac{F_n}{\delta_{adj}}$	Air flow, (lb/sec) Altitude W_a	Air flow, (lb/sec) Corrected $\frac{W_a\sqrt{\theta_T}}{\delta_T}$	Air flow, (lb/sec) Adjusted $\frac{W_a\sqrt{\theta_{adj}}}{\delta_{adj}}$
(a) Exhaust-nozzle area, 153 square inches.																		
1	5,000	1.062	0.280	1754	0.998	11,689	462	468	3281	3747	3294	2.166	2794	3191	2805	53.04	57.60	51.15
2		1.076	.312	1737	1.008	11,525	458	466	3273	3725	3319	2.134	2735	3112	2773	52.82	57.05	51.20
3		1.057	.278	1760	1.009	10,537	459	466	2275	2591	2277	1.788	1863	2122	1865	45.43	49.02	43.52
4		1.056	.278	1754	1.005	9,220	460	466	1353	1548	1358	1.441	1041	1191	1045	34.39	37.31	33.07
5		1.056	.278	1754	1.008	7,903	459	466	839	960	842	1.245	585	669	587	28.03	30.38	26.93
6		1.055	.278	1752	1.003	6,256	461	467	444	508	446	1.107	238	273	239	22.69	24.66	21.66
7	10,000	1.212	0.525	1450	0.8467	11,525	482	508	2840	3434	2851	1.957	2045	2472	2053	45.24	54.16	45.38
8		1.208	.522	1454	.8547	10,537	481	505	1907	2304	1909	1.979	1255	1516	1256	37.36	44.61	37.32
9		1.213	.527	1454	.8726	10,537	474	499	2028	2442	2030	1.620	1352	1628	1353	38.72	45.77	38.41
10		1.208	.524	1457	.8598	9,220	479	504	1208	1457	1207	1.291	674	813	674	30.58	36.39	30.44
11		1.212	.528	1455	.8584	7,903	480	506	736	885	737	1.102	295	355	295	25.00	39.75	24.85
12		1.208	.524	1450	.8696	7,903	473	499	757	917	760	1.114	322	390	323	25.04	29.75	24.89
13		1.208	.525	1454	.8467	6,256	484	510	386	466	386	.9715	59	71	59	18.56	22.22	18.60
14		1.212	.531	1455	.8757	6,256	474	499	400	480	400	.9733	69	83	69	18.83	22.22	18.68
15		1.212	.524	1450	.8503	11,525	481	506	2816	3407	2827	1.952	2025	2448	2025	45.27	54.14	45.36
16		1.212	.524	1456	.8511	11,525	482	507	2809	3385	2809	1.956	2013	2426	2013	45.36	54.11	45.31
17		1.208	.522	1454	.8576	10,537	479	504	1923	2323	1925	1.574	1265	1528	1266	37.77	45.02	37.66
18		1.209	.525	1452	.8576	9,220	480	504	1187	1434	1191	1.285	652	788	654	30.49	36.37	30.49
19		1.213	.531	1456	.8628	7,903	480	504	731	877	731	1.101	297	356	297	24.50	29.06	24.43
20		1.214	.532	1450	.8569	6,256	481	506	377	454	379	.971	58	70	58	17.93	21.35	17.97
21		1.208	.519	1457	.8554	10,537	479	505	1915	2315	1914	1.580	1262	1526	1261	37.67	45.06	37.59
22		1.207	.520	1456	.8489	9,220	484	508	1181	1428	1181	1.291	660	798	660	29.91	35.83	29.94
23		1.207	.521	1456	.8576	7,903	480	504	736	889	736	1.110	312	377	312	24.36	29.06	24.29
24		1.208	.522	1450	.8503	6,256	483	506	393	476	395	.9794	69	84	69	18.52	22.22	18.59
25	25,000	2.035	1.055	784	------	11,854	---	525	----	----	----	-----	----	----	----	-----	-----	-----
26		2.051	1.062	781	------	11,854	---	519	----	----	----	-----	----	----	----	-----	-----	-----
27		2.028	1.052	784	0.7380	11,854	428	521	3129	4199	3132	1.946	1762	2365	1764	41.25	55.56	41.21
28		2.037	1.055	782	.7402	11,525	427	521	2909	3895	2921	1.834	1577	2112	1583	40.08	53.83	40.12
29		2.030	1.054	779	.7318	10,537	430	524	2043	2752	2059	1.437	900	1212	907	34.34	46.53	34.61
30		2.040	1.059	784	.7456	9,220	428	522	1191	1585	1192	1.033	272	362	272	27.54	36.85	27.61
31		2.051	1.064	780	.7424	7,903	430	524	669	869	673	.7933	-92	-122	-93	23.65	30.31	22.79
32		2.010	1.048	788	.7396	6,256	430	521	302	405	301	.6502	-284	-381	-283	17.70	23.86	17.63
33		1.522	.792	783	.6127	11,960	430	482	2467	4409	2474	2.168	1629	2911	1654	33.49	57.80	33.59
34		1.530	.798	781	.6143	11,854	429	483	2436	4343	2448	2.136	1599	2851	1607	33.25	57.26	33.38
35		1.519	.791	784	.6127	11,525	430	483	2241	4005	2243	2.034	1428	2552	1429	32.56	56.20	32.59
36		1.523	.794	784	.6165	10,537	429	482	1608	2864	1610	1.633	898	1599	898	28.33	48.67	28.33
37		1.523	.798	782	.6203	9,220	427	480	961	1713	965	1.220	395	704	397	22.56	38.71	22.58
38		1.520	.796	784	.6188	7,903	428	482	558	993	559	.9840	97	173	97	18.40	31.56	18.38
39		1.526	.800	781	.6146	6,256	431	485	268	477	269	.8168	-83	-148	-83	13.86	23.85	13.94
40		1.221	.536	783	.5376	11,689	428	451	1883	4190	1889	2.256	1410	3137	1414	28.08	58.38	28.11
41		1.218	.532	779	.553	11,525	429	452	1817	4074	1832	2.212	1356	3040	1367	27.48	57.54	27.67
42		1.222	.541	781	.5365	11,380	429	453	1537	3412	1545	1.960	1090	2420	1095	26.21	54.41	26.31
43		1.212	.528	784	.5299	10,537	433	455	1305	2913	1306	1.799	905	2020	906	23.90	50.05	24.02
44		1.214	.533	779	.5368	9,220	427	451	770	1724	778	1.397	455	1019	459	18.76	39.16	18.85
45		1.205	.524	784	.5350	7,903	429	453	456	1021	456	1.171	207	463	206	15.08	31.52	15.09
46		1.202	.520	781	.5308	6,256	430	453	272	613	273	1.027	67	151	67	12.46	26.23	12.52
47		1.060	.297	781	.4708	11,525	444	450	1587	4045	1595	2.273	1355	3454	1362	24.41	58.07	24.92
48		1.065	.288	787	.4704	11,525	446	452	1573	3995	1569	2.259	1348	3424	1345	24.48	58.09	24.85
49		1.061	.290	784	.4739	10,866	443	448	1295	3297	1298	2.028	1086	2765	1087	22.45	53.23	22.81
50		1.059	.287	783	.4721	10,537	443	450	910	2322	913	1.692	745	1901	747	17.93	42.60	18.26
51		1.058	.287	781	.4690	9,220	445	451	641	1640	644	1.427	491	1256	493	16.22	38.73	16.58
52		1.055	.280	780	.4658	7,803	446	453	393	1009	395	1.261	277	711	279	12.90	30.95	13.21
53		1.053	.276	780	------	6,256	---	453	----	----	----	-----	----	----	----	-----	-----	-----
54	40,000	2.043	1.059	394	0.4221	11,854	390	475	1783	4721	1774	2.128	1072	2839	1067	22.33	56.7	22.13
55		2.028	1.052	393	.4102	11,525	396	482	1688	4515	1684	2.057	998	2670	996	21.63	55.87	21.65
56		2.041	1.058	391	.4127	11,525	394	480	1653	4417	1658	2.048	962	2570	965	21.60	55.62	21.69
57		2.067	1.069	388	.4136	10,537	393	482	1169	3104	1181	1.573	578	1535	584	18.31	46.89	18.49
58		2.043	1.062	393	.4186	9,220	392	479	733	1939	731	1.149	245	648	244	15.22	38.75	15.17
59		2.054	1.066	391	.4216	7,903	390	477	436	1159	439	.8536	39	103	39	12.43	31.55	12.42
60		1.557	.819	394	.3418	10,657	398	450	873	3069	882	1.684	503	1768	508	14.86	48.70	15.10
61		1.515	.791	388	.3398	10,537	399	448	868	3087	864	1.714	509	1810	506	14.92	49.34	14.96
62		1.529	.789	393	.3329	10,072	407	457	734	2597	732	1.554	402	1422	401	13.83	45.01	13.73
63		1.525	.800	394	.3392	9,220	402	452	534	1901	536	1.282	244	854	241	12.17	40.10	12.24
64		1.518	.794	394	.3370	7,903	402	453	306	1084	304	1.050	67	237	67	9.88	32.65	9.918
65		1.520	.798	392	.3346	6,256	404	456	147	522	147	.854	-40	-142	-40	7.66	25.46	7.767
66		1.206	.524	393	.2682	10,072	428	452	522	2330	521	1.595	349	1558	348	10.45	43.49	1087
67		1.206	.524	393	.2695	10,072	427	450	521	2236	500	1.589	328	1464	327	10.44	43.48	1086
68		1.203	.524	394	.2704	9,220	427	450	377	1680	378	1.387	223	993	222	9.34	38.74	9.586
69		1.202	.524	391	.2678	7,903	429	452	242	1087	243	1.188	113	506	113	7.80	32.71	8.174
70		1.191	.512	393	.2651	6,256	430	453	138	621	138	1.036	40	180	40	6.05	25.45	6.310

2470

SIMULATED-FLIGHT CONDITIONS WITH MIXER VANES INSTALLED

Engine total-temperature ratio $\frac{T_5}{T_2}$	Fuel flow, (lb/hr): Altitude W_f	Fuel flow: Corrected $\frac{W_f}{\delta_T\sqrt{\theta_T}}$	Fuel flow: Adjusted $\frac{W_f}{\delta_{adj}\sqrt{\theta_{adj}}}$	Turbine-outlet total pressure P_5 $\left(\frac{lb}{sq\ ft\ abs}\right)$	Specific fuel consumption $\frac{lb/hr}{lb}$: Altitude $\frac{W_f}{F_n}$	Specific fuel consumption: Corrected $\frac{W_f}{F_n\sqrt{\theta_T}}$	Specific fuel consumption: Adjusted $\frac{W_f}{F_n\sqrt{\theta_{adj}}}$	Exhaust gas total temperature, (°R): Altitude T_8	Exhaust gas total temperature: Corrected $\frac{T_8}{\theta_T}$	Exhaust gas total temperature: Adjusted $\frac{T_8}{\theta_{adj}}$	Corrected engine speed $\frac{N}{\sqrt{\theta_T}}$ (rpm)	Adjusted engine speed $\frac{N}{\sqrt{\theta_{adj}}}$ (rpm)	Run
(a) Exhaust-nozzle area, 153 square inches.													
3.648	3470	4168	3626	4014	1.242	1.306	1.293	1711	1894	1854.7	12,297	12,168	1
3.621	3405	4084	3612	3967	1.245	1.312	1.302	1691	1878	1849.9	12,147	12,055	2
3.268	2410	2896	2521	3321	1.293	1.365	1.352	1525	1695	1633.1	11,117	11,011	3
2.949	1635	1971	1714	2666	1.571	1.655	1.640	1377	1530	1499.5	9,718	9,626	4
2.758	1220	1472	1280	2303	2.085	2.200	2.179	1285	1430	1403.2	8,338	8,259	5
2.594	935	1128	980	2045	3.930	4.139	4.097	1214	1348	1319.6	6,588	6,525	6
3.36	2845	3475	2859	3425	1.391	1.406	1.393	1710	1744	1713	11,640	11,537	7
2.97	1930	2359	1936	2785	1.538	1.556	1.541	1506	1542	1515	10,663	10,558	8
2.976	1980	2430	2000	2847	1.464	1.493	1.478	1488	1545	1515	10,737	10,632	9
2.584	1305	1596	1309	2265	1.936	1.963	1.944	1305	1342	1315	9,349	9,257	10
2.298	1000	1217	1004	1939	3.390	3.431	3.400	1165	1193	1171	7,998	7,927	11
2.319	1005	1241	1019	1948	3.121	3.183	3.152	1157	1203	1182	8,061	7,982	12
2.020	770	936	770	1706	13.06	13.15	13.03	1032	1049	1030	6,306	6,249	13
2.014	780	954	788	1715	11.31	11.51	11.41	1009	1045	1027	6,369	6,312	14
3.339	2790	3416	2807	3414	1.379	1.395	1.382	1693	1734	1700	11,663	11,548	15
3.32	2795	3402	2798	3434	1.388	1.402	1.390	1690	1724	1694	11,640	11,537	16
2.956	1920	2352	945	2765	1.518	1.540	.7462	1493	1535	1505	10,685	10,579	17
2.561	1300	1591	1308	2251	1.994	2.020	2.000	1298	1330	1304	9,340	9,248	18
2.288	1006	1222	1009	1841	3.390	3.428	3.397	1160	1188	1167	7,998	7,927	19
2.016	785	956	790	1707	13.54	13.69	13.57	1024	1047	1029	6,325	6,269	20
2.982	1935	2372	1942	2783	1.534	1.555	1.540	1506	1548	1518	10,685	10,579	21
2.571	1291	1575	1240	2259	1.956	1.974	1.955	1311	1335	1308	9,305	9,210	22
2.298	983	1203	986	1943	3.151	3.192	3.160	1163	1193	1169.9	8,006	7,927	23
-----	769	942	772	1710	11.15	11.26	11.14	----	----	------	6,319	6,256	24
-----	2555	----	----	----	------	------	------	----	----	------	------	------	25
-----	2495	----	----	----	------	------	------	----	----	------	------	------	26
3.264	2560	3422	2568	3069	1.454	1.447	1.456	1707	1884	1715.5	11,809	11,878	27
3.096	2275	3037	2291	2901	1.443	1.438	1.447	1616	1807	1627.3	11,492	11,560	28
2.538	1460	1940	1462	2258	1.611	1.600	1.611	1335	1317	1335	10,466	10,537	29
1.910	943	1248	946	1642	3.470	3.449	3.474	1001	991	1006	9,176	9,258	30
1.446	688	908	692	1263	-7.478	-7.424	-7.478	762	750	672	7,843	7,903	31
1.094	500	668	498	1026	-1.760	-1.754	-1.761	575	567	575	6,226	6,258	32
3.678	2285	4226	2292	2567	1.403	1.452	1.403	1780	1906	1780	12,380	11,961	33
3.634	2230	4115	2243	2538	1.395	1.443	1.396	1759	1884	1763	12,269	11,866	34
3.481	2015	3728	2017	2408	1.411	1.461	1.411	1685	1806	1685	11,928	11,525	35
2.925	1365	2522	1367	1940	1.520	1.577	1.521	1413	1519	1416	10,927	10,548	36
2.341	925	1713	932	1448	2.342	2.433	2.349	1126	1216	1134	9,580	9,248	37
1.954	745	1376	747	1170	7.680	7.989	7.691	942	1015	946.1	8,205	7,919	38
1.541	570	1047	572	972	------	------	------	749	799	743	6,462	6,248	39
3.823	1891	4506	1901	2145	1.341	1.436	1.344	1732	1987	1740.6	12,519	11,712	40
3.740	1829	4392	1846	2088	1.349	1.445	1.350	1694	1943	1697.4	12,343	11,537	41
4.013	1728	4100	1739	1868	1.585	1.694	1.587	1822	2083	1825.6	12,144	11,371	42
3.319	1325	3152	1321	1705	1.465	1.560	1.459	1517	1723	1506.5	11,232	10,500	43
2.814	940	2259	851	1520	2.065	2.218	2.973	1269	1461	1277.8	9,893	9,248	44
2.467	773	1854	775	1107	3.735	4.00	3.739	1115	1279	1117.2	8,464	7,911	45
2.230	667	1609	670	964	9.96	10.66	9.955	1010	1158	1010	6,700	6,256	46
3.923	1700	4642	1681	1987	1.255	1.344	1.235	1773	2034	1717.16	------	11,342	47
3.894	1675	4557	1641	1882	1.242	1.331	1.220	1764	2025	1700.6	12,343	11,316	48
3.564	1374	3758	1355	1685	1.265	1.359	1.247	1604	1849	1557.0	11,670	10,705	49
3.958	1243	3407	1229	1403	1.669	1.792	1.644	1781	2053	1728.8	11,317	10,381	50
3.126	690	2439	879	1180	1.812	1.941	1.782	1413	1621	1365.4	9,875	9,063	51
2.887	745	2049	736	1051	2.690	2.881	2.643	1308	1500	1261.0	8,464	7,760	52
----	633	----	----	----	------	------	------	----	----	------	------	------	53
3.679	1510	4171	1508	1700	1.408	1.469	1.414	1755	1909	1768	12,364	11,901	54
3.537	1410	3903	1401	1627	1.413	1.462	1.408	1712	1834	1698.9	11,928	11,481	55
3.541	1395	3869	1397	1822	1.45	1.505	1.448	1707	1836	1702.7	11,963	11,510	56
2.899	935	2575	944	1254	1.618	1.678	1.618	1400	1505	1400	10,927	10,537	57
2.200	720	1978	719	919	2.939	3.053	2.943	1058	1143	1061.1	9,580	9,229	58
1.657	570	1571	574	683	14.62	1.523	14.67	792	860	798.3	8,235	7,935	59
3.436	856	3227	860	1014	1.709	1.825	1.692	1549	1783	1520	11,306	10,471	60
3.483	874	3343	863	1020	1.716	1.847	1.703	1564	1808	1514	11,327	10,458	61
2.983	752	2827	737	929	1.872	1.988	1.838	1369	1547	1361	10,707	9,879	62
2.539	675	2550	664	769	2.79	2.988	2.756	1150	1319	1042	9,875	9,116	63
2.066	573	2176	564	615	8.56	1.964	8.463	936	1074	809	8,406	7,814	64
1.716	495	1876	488	509	------	------	------	781	891	740	6,681	6,170	65
3.310	680	3250	650	156	1.948	2.066	1.868	1496	1716	1394	10,767	9,651	66
3.357	695	3330	665	733	2.119	2.274	2.034	1514	1443	1375	10,807	9,863	67
2.953	632	3025	693	659	2.835	3.045	2.717	1329	1532	1223	9,902	8,846	68
2.633	570	2741	548	550	5.04	5.398	4.832	1190	1365	1090	8,464	7,564	69
2.408	495	2386	472	486	12.37	13.25	11.83	1091	1251	997	6,700	5,981	70

12470

TABLE I. - PERFORMANCE AT VARIOUS ENGINE-OPERATING AND

Run	Altitude (ft)	Ram pressure ratio $\frac{P_1}{p_0}$	Flight Mach number M_0	Tunnel static pressure p_0 $\left(\frac{\text{lb}}{\text{sq ft abs.}}\right)$	Reynolds number index $\frac{\delta_T}{\phi\sqrt{\theta_T}}$	Engine speed N (rpm)	Equivalent ambient air temperature t (°R)	Engine-inlet indicated temperature T_1 (°R)	Jet thrust (lb): Altitude F_j	Jet thrust (lb): Corrected $\frac{F_j}{\delta_T}$	Jet thrust (lb): Adjusted $\frac{F_j}{\delta_{adj}}$	Engine total-pressure ratio $\frac{P_5}{P_2}$	Net thrust (lb): Altitude F_n	Net thrust (lb): Corrected $\frac{F_n}{\delta_T}$	Net thrust (lb): Adjusted $\frac{F_n}{\delta_{adj}}$	Air flow (lb/sec): Altitude W_a	Air flow (lb/sec): Corrected $\frac{W_a\sqrt{\theta_T}}{\delta_T}$	Air flow (lb/sec): Adjusted $\frac{W_a\sqrt{\theta_{adj}}}{\delta_{adj}}$
(b) Exhaust-nozzle area, 164 square inches.																		
1	5,000	1.056	0.280	1754	0.9921	12,513	464	470	3248	3709	3261	2.089	2748	3138	2759	54.35	59.13	52.52
2		1.056	.280	1754	1.003	12,513	460	466	3254	3716	3267	2.087	2754	3145	2765	54.58	59.11	52.49
3		1.058	.286	1756	1.001	11,525	461	468	2647	3243	2856	1.943	2356	2682	2362	52.65	57.02	50.83
4		1.055	.278	1754	.9840	10,537	463	470	2103	2404	2111	1.677	1682	1923	1689	46.34	50.42	44.73
5		1.055	.278	1754	.9930	9,220	464	470	1258	1439	1263	1.371	938	1075	942	35.12	38.28	33.94
6		1.053	.273	1753	.9990	7,903	462	468	771	884	775	1.208	527	604	530	27.26	29.69	26.32
7		1.053	.273	1755	.9830	6,256	464	470	409	469	411	1.081	234	266	235	19.36	21.36	18.92
8	10,000	1.205	0.516	1454	0.8418	12,513	484	508	3038	3686	3038	1.984	2195	2647	2197	48.70	58.65	48.60
9		1.204	.512	1453	.8467	12,513	482	506	3051	3689	3037	1.982	2200	2677	2204	48.45	58.29	48.50
10		1.208	.519	1457	.8418	11,525	486	510	2495	3016	2493	1.770	1697	2052	1696	45.63	55.04	45.92
11		1.212	.524	1454	.8576	10,537	480	504	1839	2218	1841	1.506	1136	1372	1139	40.01	47.65	39.93
12		1.203	.515	1456	.8496	9,220	481	507	1067	1294	1067	1.221	545	661	545	30.32	36.38	30.26
13		1.207	.522	1458	.8340	7,903	490	516	632	763	632	1.063	207	250	207	24.12	29.06	24.29
14		1.203	.519	1456	.8525	6,256	481	506	351	425	351	.9594	29	35	29	18.57	22.25	18.53
15		1.205	.514	1457	.8482	12,513	483	505	3053	3705	3051	1.988	2218	2690	2216	48.53	58.28	48.50
16		1.207	.518	1461	.8547	12,513	480	505	3076	3713	3066	1.985	2226	2687	2218	49.18	58.62	48.87
17		1.206	.516	1459	.8525	11,525	481	505	2545	3077	2540	1.790	1751	2117	1747	46.06	55.03	45.86
18		1.212	.527	1450	.8532	10,537	480	506	1845	2229	1852	1.506	1143	1381	1146	39.88	47.62	39.92
19		1.215	.527	1449	.8489	9,220	483	508	1072	1298	1077	1.220	544	658	547	29.92	35.84	30.07
20		1.206	.520	1454	.8606	7,903	478	502	655	793	656	1.070	233	282	233	24.36	29.06	24.26
21		1.209	.525	1458	.8598	6,256	480	506	344	415	344	.9585	16	19	16	18.71	22.21	18.65
22	25,000	2.032	1.052	784	0.7510	12,513	432	524	3148	4221	3148	1.866	1709	2492	1711	43.11	58.33	43.24
23		2.029	1.051	785	.7299	12,513	432	526	3184	4246	3164	1.870	1735	2501	1736	42.95	56.05	43.04
24		2.030	1.052	787	.7321	11,525	432	526	2606	3484	2601	1.628	1276	1877	1273	38.96	53.83	38.91
25		2.031	1.053	785	.7364	10,537	430	524	1859	2487	1858	1.292	709	1072	709	34.58	46.54	34.58
26		2.004	1.043	792	.7446	9,220	427	519	1101	1479	1091	.9670	176	319	174	28.15	31.81	27.82
27		2.021	1.051	791	.7429	7,903	428	524	647	862	642	.7602	-105	-104	-104	22.70	30.35	22.48
28		1.506	.781	786	.6083	12,513	431	482	2299	4140	2296	1.896	1463	2635	1461	33.86	56.88	33.83
29		1.501	.777	788	.6109	12,513	429	480	2283	4118	2274	2.000	1452	2619	1446	33.91	56.90	33.76
30		1.505	.779	787	.6135	11,525	429	479	2003	3609	1998	1.627	1195	2153	1192	32.86	57.01	32.74
31		1.504	.780	786	.6135	10,537	428	480	1463	2636	1461	1.513	753	1357	752	28.87	50.03	28.77
32		1.508	.785	787	.6169	9,220	428	480	847	1518	845	1.136	285	511	284	22.73	39.21	22.63
33		1.500	.780	786	.6127	7,903	430	481	500	901	499	.9446	52	94	52	18.18	31.58	18.16
34		1.498	.779	787	.6127	6,256	451	481	229	412	228	.8156	-98	-176	-98	13.26	23.05	13.24
35		1.218	.529	786	.5400	12,513	427	449	1827	4065	1825	2.115	1362	3008	1350	28.51	59.13	28.33
36		1.210	.520	778	.5280	12,513	430	451	1770	4006	1786	2.107	1313	2971	1325	27.83	58.83	28.08
37		1.220	.533	781	.5350	11,525	430	461	1594	3561	1602	1.956	1130	2524	1136	27.54	57.53	27.88
38		1.211	.524	786	.5408	10,537	426	446	1221	2728	1219	1.899	809	1807	808	25.01	51.97	24.88
39		1.206	.518	781	.5325	9,220	429	450	698	1576	701	1.330	387	874	389	19.05	40.10	19.11
40		1.211	.525	781	.5362	7,903	427	451	415	931	417	1.121	166	373	167	15.06	31.56	15.11
41		1.208	.521	783	.5328	6,256	430	455	214	481	215	.9788	33	74	33	10.98	23.04	11.01
42		1.062	.286	789	.4726	12,513	445	451	1543	3910	1535	2.175	1312	3325	1305	25.13	59.43	25.43
43		1.068	.302	784	.4721	12,513	446	451	1537	3895	1539	2.166	1293	3278	1294	26.21	59.87	25.88
44		1.068	.299	782	.4693	11,525	446	452	1332	3387	1337	2.006	1098	2792	1102	24.31	57.81	24.84
45		1.067	.299	781	.4693	11,525	446	451	1330	3386	1337	2.008	1095	2788	1100	24.38	58.05	24.84
46		1.065	.292	786	.4735	10,537	443	450	1017	2580	1016	1.760	812	2060	811	21.84	51.65	22.15
47		1.057	.278	786	.4697	9,220	446	451	588	1503	586	1.405	444	1133	443	16.25	38.74	16.53
48		1.056	.263	782	.4632	7,903	448	453	333	859	334	1.236	244	630	245	10.54	25.43	10.80
49		1.053	.276	778	.4583	6,256	450	457	161	415	162	1.091	79	204	80	9.17	22.20	9.45
50	40,000	2.026	1.048	391	0.4124	12,513	391	476	1715	4634	1720	2.024	994	2686	997	22.64	59.16	22.88
51		2.043	1.056	391	.4184	12,513	389	474	1753	4689	1758	2.029	1023	2737	1026	22.99	58.90	22.84
52		2.010	1.044	394	.4139	11,525	392	476	1500	4044	1492	1.856	805	2170	801	22.07	57.05	21.94
53		2.051	1.061	393	.4191	10,537	391	478	1159	3069	1156	1.487	535	1417	534	19.64	49.71	19.46
54		2.031	1.055	392	.4191	9,220	389	475	652	1744	652	1.054	151	404	151	15.81	40.51	15.73
55		2.020	1.050	394	.4170	7,903	391	477	393	1051	391	.8167	4	11	4	12.30	31.55	12.21
56		2.038	1.059	390	.4102	6,256	395	484	159	425	160	.6372	-147	-393	-148	9.54	24.85	9.62
57		1.526	.793	394	.3342	12,513	405	453	1234	4581	1228	2.129	808	2868	804	17.53	58.32	17.71
58		1.520	.790	398	.3376	12,475	404	452	1259	4440	1240	2.113	826	2913	814	17.92	59.12	17.90
59		1.529	.796	395	.3381	11,525	401	450	1111	3944	1108	1.977	693	2460	691	17.20	56.98	17.32
60		1.528	.794	394	.3380	10,537	401	451	857	3037	853	1.653	463	1712	461	15.42	50.99	15.50
61		1.513	.787	396	.3370	9,220	403	452	476	1690	471	1.195	188	667	186	11.95	39.63	11.99
62		1.520	.794	394	.3357	7,903	404	455	328	1162	326	.9799	93	330	93	9.68	32.12	9.77
63		1.516	.791	390	.3329	6,256	403	453	134	481	135	.8285	-49	-178	-49	7.58	25.46	7.72
64		1.216	.524	391	.2671	12,375	429	450	909	4084	912	2.212	678	3046	680	13.98	58.62	14.65
65		1.238	.552	391	.2719	12,260	427	451	904	3977	907	2.125	656	2888	658	14.27	58.65	14.91
66		1.220	.532	396	.2726	12,113	427	450	895	3945	886	2.131	656	2892	649	14.26	56.59	14.70
67		-----	-----	394	-----	12,100	---	451	----	-----	----	-----	----	----	----	-----	-----	-----
68		1.214	.524	393	.2688	11,523	429	450	819	3647	815	2.044	590	2634	569	15.76	57.32	14.32
69		-----	-----	394	-----	10,537	---	452	----	-----	----	-----	----	----	----	-----	-----	-----
70		1.214	.532	392	.2673	9,220	431	454	339	1510	339	1.314	186	829	186	9.07	37.79	9.50
71		1.189	.514	396	.2673	7,903	431	454	189	844	187	1.127	73	326	72	7.12	29.73	7.38
72		1.212	.528	392	.2673	6,256	430	454	82	366	82	.9915	-7	-31	-7	5.32	22.21	5.56
73	47,000	1.224	0.541	277	0.1915	12,063	427	451	637	3988	646	2.154	466	2917	473	10.04	58.65	10.61
74		1.216	.526	287	.1979	11,938	426	448	641	3904	628	2.144	472	2878	462	10.19	57.86	10.38
75		1.208	.519	283	.1930	11,638	428	450	592	3685	589	2.074	432	2689	429	9.78	56.74	10.14
76		1.220	.535	282	.1935	11,613	429	451	602	3725	600	2.073	437	2704	435	9.81	56.70	10.21
77		1.246	.562	276	.1927	11,275	426	453	568	3452	568	1.956	390	2413	397	9.62	55.03	10.08
78		1.232	.547	278	.1930	11,263	424	448	559	3499	569	1.985	396	2479	403	9.50	56.31	10.05
79	55,000	1.631	0.798	196	0.1727	12,100	384	443	634	4502	618	2.185	420	2982	409	8.86	58.32	8.88
80		1.521	.787	194	.1652	12,000	402	451	606	4392	597	2.140	399	2892	393	8.60	58.16	8.55
81		1.556	.798	184	.1658	11,728	404	454	583	4182	574	2.064	379	2719	373	8.33	55.84	8.32
82		1.552	.808	192	.1660	11,563	402	453	571	4096	568	2.037	365	2818	363	8.33	55.88	8.38

[redacted]

2470

SIMULATED-FLIGHT CONDITIONS WITH MIXER VANES INSTALLED - Continued

Engine total-temperature ratio $\frac{T_5}{T_2}$	Fuel flow, (lb/hr) Altitude W_f	Corrected $\frac{W_f}{\delta_T \sqrt{\theta_T}}$	Adjusted $\frac{W_f}{\delta_{adj} \sqrt{\theta_{adj}}}$	Turbine-outlet total pressure P_5 $\left(\frac{\text{lb}}{\text{sq ft abs.}}\right)$	Specific fuel consumption $\frac{\text{lb/hr}}{\text{lb}}$ Altitude $\frac{W_f}{F_n}$	Corrected $\frac{W_f}{F_n \sqrt{\theta_T}}$	Adjusted $\frac{W_f}{F_n \sqrt{\theta_{adj}}}$	Exhaust gas total temperature, (°R) Altitude T_8	Corrected $\frac{T_8}{\theta_T}$	Adjusted $\frac{T_8}{\theta_{adj}}$	Corrected engine speed $\frac{N}{\sqrt{\theta_T}}$ (rpm)	Adjusted engine speed $\frac{N}{\sqrt{\theta_{adj}}}$ (rpm)	Run
(b) Exhaust-nozzle area, 164 square inches.													
3.522	3405	4083	3552	3870	1.238	1.301	1.287	1659	1830	1792	13,139	13,001	1
3.529	3395	4086	3558	3867	1.234	1.299	1.287	1648	1831	1795	13,139	13,064	2
3.207	2810	3367	2840	3611	1.192	1.256	1.245	1504	1665	1635	12,124	12,021	3
2.881	2100	2523	2193	3104	1.248	1.312	1.298	1354	1496	1465	11,074	10,958	4
2.682	1500	1802	1565	2536	1.600	1.619	1.662	1263	1393	1364	9,681	9,580	5
2.563	1177	1419	1231	2232	2.232	2.349	2.324	1202	1331	1303	8,314	8,227	6
2.463	921	1108	962	2014	3.935	4.132	4.090	1160	1279	1256	6,569	6,500	7
3.269	2960	3629	2960	3456	1.348	1.361	1.347	1667	1697	1664	12,626	12,499	8
3.268	2935	3614	2944	3445	1.335	1.350	1.335	1657	1687	1660	12,663	12,526	9
2.920	2320	2824	2311	3098	1.368	1.377	1.363	1495	1516	1486	11,606	11,489	10
2.613	1712	2091	1719	2642	1.505	1.524	1.509	1322	1356	1330	10,674	10,569	11
2.357	1190	1460	1192	2131	2.182	2.209	2.187	1195	1224	1200	9,331	9,238	12
2.147	951	1150	944	1863	4.595	4.604	4.560	1110	1114	1109	7,919	7,846	13
1.953	754	924	756	1677	26.0	26.31	26.07	990	1014	994	6,331	6,269	14
3.281	2970	3639	2968	3467	1.34	1.353	1.339	1670	1703	1670	12,638	12,513	15
3.283	2990	3656	2989	3480	1.344	1.361	1.347	1661	1704	1570	12,676	12,551	16
2.947	2355	2881	2355	3132	1.345	1.361	1.348	1494	1530	1499	11,663	11,548	17
2.623	1710	2091	1722	2641	1.498	1.514	1.500	1330	1362	1339	10,663	10,569	18
2.343	1195	1458	1201	2135	2.197	2.217	2.197	1195	1217	1195	9,303	9,220	19
2.165	960	1180	966	1871	4.12	4.180	4.142	1091	1124	1120	8,022	7,943	20
1.980	750	914	751	1687	46.9	47.50	47.00	992	1018	998	6,337	6,275	21
3.045	2430	3233	2426	2942	1.422	1.410	1.418	1608	1581	1600.6	12,407	12,484	22
3.072	2455	3269	2449	2949	1.415	1.404	1.412	1619	1595	1611.5	12,418	12,484	23
2.688	1839	2436	1830	2578	1.442	1.429	1.438	1419	1395	1412.5	11,427	11,498	24
2.227	1228	1634	1228	2043	1.732	1.722	1.732	1169	1156	1169	10,477	10,537	25
1.742	877	1176	872	1525	4.885	4.977	5.000	906	904	912.3	9,211	9,248	26
1.373	637	846	633	1206	-6.07	-6.048	-6.76	718	713	721.6	7,873	7,918	27
3.329	2017	3760	2012	2345	1.378	1.427	1.377	1611	1725	1607	12,951	12,498	28
3.356	2025	3796	2019	2346	1.395	1.449	1.396	1614	1743	1617	13,001	12,526	29
3.008	1652	3092	1650	2145	1.383	1.436	1.384	1447	1563	1450	11,974	11,537	30
2.585	1203	2254	1205	1778	1.597	1.661	1.600	1241	1343	1247	10,958	10,558	31
2.081	879	1636	879	1540	3.087	3.204	3.091	1001	1081	1006	9,680	9,258	32
1.772	700	1310	699	1109	13.47	13.98	13.46	854	920	854	8,203	7,903	33
1.482	561	1048	559	956	-5.725	-5.939	-5.714	716	770	714	6,487	6,248	34
3.676	1815	4332	1818	2011	1.344	1.440	1.346	1658	1908	1670	13,926	12,551	35
3.634	1768	4286	1784	1970	1.347	1.442	1.347	1646	1888	1646	13,401	12,513	36
3.247	1490	3559	1497	1852	1.319	1.410	1.319	1474	1685	1474	12,320	11,525	37
2.911	1180	2835	1183	1609	1.459	1.569	1.465	1307	1511	1319	11,327	10,579	38
2.513	868	2100	875	1246	2.224	2.403	2.245	1136	1303	1138	9,875	9,239	39
2.262	735	1771	741	1057	4.43	4.753	4.440	1020	1174	1027	8,480	7,927	40
2.077	587	1413	589	922	17.8	19.06	17.79	941	1079	941	6,700	6,258	41
3.788	1670	4533	1634	1816	1.274	1.364	1.252	1712	1964	1654	13,401	12,300	42
3.757	1661	4508	1635	1809	1.265	1.376	1.263	1702	1952	1645	13,401	12,300	43
3.350	1373	3733	1353	1669	1.250	1.337	1.228	1521	1739	1466	12,320	11,316	44
3.346	1373	3738	1355	1669	1.254	1.341	1.231	1519	1736	1464	12,320	11,316	45
3.051	1116	3037	1098	1468	1.375	1.474	1.353	1376	1584	1336	11,306	10,381	46
2.815	842	2302	826	1165	1.896	2.032	1.863	1275	1462	1229	9,875	9,053	47
2.683	717	1976	705	1015	2.94	3.139	2.877	1218	1392	1169	8,448	7,743	48
2.65	589	1620	581	895	7.46	7.949	7.291	1202	----	1149	6,669	6,115	49
3.442	1420	4002	1427	1585	1.428	1.490	1.432	1642	1788	1650	13,051	12,538	50
3.442	1437	4013	1448	1605	1.405	1.466	1.412	1640	1788	1656	13,064	12,576	51
3.090	1174	3300	1169	1475	1.459	1.520	1.460	1469	1598	1473	12,021	11,557	52
2.588	887	2444	887	1188	1.658	1.725	1.662	1230	1333	1236	10,969	10,558	53
1.937	672	1878	675	834	4.445	4.649	4.470	922	1005	931.2	9,626	9,266	54
1.514	539	1503	537	646	134.7	140.5	135.0	722	786	725.6	8,243	7,919	55
1.101	421	1166	422	504	-2.865	-2.966	-2.857	533	571	530.2	6,475	6,240	56
3.697	1207	4572	1183	1269	1.493	1.594	1.472	1686	1919	1636	13,351	12,327	57
3.703	1186	4472	1152	1268	1.435	1.535	1.416	1681	1921	1635	13,336	12,304	58
3.338	1002	3809	980	1178	1.446	1.548	1.431	1509	1731	1479	12,343	11,409	59
2.861	800	3037	788	987	1.658	1.774	1.640	1293	1485	1267	11,285	10,451	60
2.254	632	2403	618	712	3.365	3.601	3.319	1021	1171	995.7	9,875	9,105	61
1.938	532	2013	522	585	5.72	6.108	5.645	882	1006	858	8,440	7,795	62
1.603	447	1721	443	488	-9.12	-9.776	-9.000	726	833	708	6,700	6,178	63
3.872	1017	4893	976	1042	1.500	1.606	1.435	1750	2007	1603	13,254	11,844	64
3.722	982	4628	945	1022	1.498	1.604	1.436	1686	1934	1551	13,120	11,753	65
3.714	966	4571	918	1023	1.473	1.581	1.413	1675	1928	1541	12,997	11,821	66
-----	967	----	----	1020	-----	-----	-----	----	----	----	-----	-----	67
3.489	877	4192	838	969	1.487	1.592	1.424	1577	1809	1449	12,343	11,043	68
-----	697	----	----	801	-----	-----	-----	----	----	----	-----	-----	69
2.641	587	2798	561	624	3.156	3.376	3.016	1199	1370	1093	9,856	8,804	70
2.438	518	2473	490	534	7.092	7.589	6.781	1107	1265	1010	8,448	7,547	71
2.172	438	2089	419	470	-62.56	-6.686	-59.86	985	1127	901	6,688	5,981	72
3.798	743	4983	725	728	1.595	1.708	1.530	1716	1968	1579	12,919	11,573	73
3.747	747	4891	702	744	1.633	1.699	1.519	1686	1944	1555	12,821	11,466	74
3.608	700	4674	666	705	1.621	1.738	1.553	1627	1873	1494	12,488	11,152	75
3.587	700	4640	668	709	1.603	1.716	1.533	1625	1864	1489	12,438	11,115	76
3.408	655	4340	640	669	1.680	1.800	1.613	1544	1771	1424	12,076	10,830	77
3.468	657	4420	644	671	1.680	1.783	1.598	1557	1800	1443	12,108	10,844	78
3.928	688	5283	669	651	1.636	1.771	1.636	1743	2038	1738	13,080	12,084	79
3.821	660	5124	643	625	1.654	1.772	1.637	1727	1981	1688	12,852	11,864	80
3.675	636	4870	617	609	1.678	1.792	1.654	1672	1908	1626	12,522	11,564	81
3.579	625	4792	615	601	1.711	1.830	1.693	1625	1857	1589	12,361	11,432	82

TABLE I. - PERFORMANCE AT VARIOUS ENGINE-OPERATING AND

Run	Altitude (ft)	Ram pressure ratio $\frac{P_1}{p_0}$	Flight Mach number M_0	Tunnel static pressure p_0 $\left(\frac{lb}{sq\ ft\ abs.}\right)$	Reynolds number index $\frac{\delta_T}{\phi\sqrt{\theta_T}}$	Engine speed N (rpm)	Equivalent ambient air temperature t (°R)	Engine-inlet indicated temperature T_1 (°R)	Jet thrust (lb): Altitude F_j	Jet thrust (lb): Corrected $\frac{F_j}{\delta_T}$	Jet thrust (lb): Adjusted $\frac{F_j}{\delta_{adj}}$	Engine total-pressure ratio $\frac{P_5}{P_2}$	Net thrust (lb): Altitude F_n	Net thrust (lb): Corrected $\frac{F_n}{\delta_T}$	Net thrust (lb): Adjusted $\frac{F_n}{\delta_{adj}}$	Air flow (lb/sec): Altitude W_a	Air flow (lb/sec): Corrected $\frac{W_a\sqrt{\theta_T}}{\delta_T}$	Air flow (lb/sec): Adjusted $\frac{W_a\sqrt{\theta_{adj}}}{\delta_{adj}}$
(c) Exhaust-nozzle area, 192 square inches.																		
1	5,000	1.061	0.278	1759	1.001	12,513	461	467	2700	3078	2703	1.797	2202	2510	2204	54.87	59.42	52.66
2		1.066	.292	1752	1.001	12,513	461	466	2729	3106	2743	1.798	2204	2508	2215	54.88	58.38	52.88
3		1.080	.283	1761	1.009	11,525	460	466	2366	2686	2366	1.685	1670	2124	1670	55.63	57.81	51.37
4		1.062	.287	1756	1.008	10,537	459	466	1808	2058	1813	1.495	1362	1550	1366	47.57	51.38	45.68
5		1.057	.278	1760	1.000	9,220	463	469	1078	1226	1077	1.272	747	851	748	38.13	39.16	34.78
6		1.057	.280	1755	1.000	7,903	463	469	653	746	655	1.145	391	447	392	28.49	30.97	27.48
7		1.056	.280	1763	.9970	6,256	465	472	362	412	362	1.055	160	182	160	21.99	23.64	21.16
8	10,000	1.206	0.516	1452	0.8575	12,513	486	510	2483	3017	2490	1.695	1641	1994	1646	48.55	58.60	48.84
9		1.207	.518	1452	.8503	12,513	480	504	2534	3079	2542	1.711	1689	2052	1694	48.69	58.67	48.89
10		1.209	.520	1453	.8439	11,525	484	509	2094	2536	2098	1.541	1291	1563	1294	46.10	55.32	46.24
11		1.207	.520	1454	.8475	10,537	484	507	1528	1850	1530	1.330	831	1006	832	38.98	47.98	40.04
12		1.208	.524	1452	.8482	9,220	484	508	935	1129	936	1.129	380	460	381	31.53	37.60	31.66
13		1.206	.521	1452	.8496	7,903	483	507	565	684	567	1.017	133	161	133	24.77	29.70	24.84
14		1.205	.521	1455	.8432	6,256	487	511	314	379	314	.9326	-10	-12	-10	18.48	22.19	18.57
15		1.209	.519	1455	.9662	12,513	437	507	2560	3100	2563	1.701	1715	4500	1717	51.18	58.35	48.75
16		1.209	.519	1452	.8432	12,513	484	508	2550	3093	2558	1.696	1707	4486	1712	48.50	58.30	48.83
17		1.211	.522	1454	.8439	11,525	485	509	2136	2585	2140	1.538	1335	4076	1336	45.86	56.05	46.00
18		1.208	.520	1454	.8518	10,537	482	505	1632	1855	1534	1.336	836	3470	837	40.03	47.98	40.03
19		1.207	.522	1452	.8439	9,220	486	509	906	1097	909	1.121	355	2842	356	31.44	37.92	31.63
20		1.208	.523	1454	.8453	7,903	484	510	560	676	561	1.011	125	2498	125	24.78	28.71	24.63
21		1.208	.524	1450	.8439	6,256	484	510	302	365	303	.9308	-35	2238	-35	19.19	23.06	18.29
22	25,000	2.031	1.051	784	0.7386	12,513	428	519	2808	3771	2811	1.608	1373	1844	1374	44.25	58.34	43.27
23		2.046	1.057	777	.7746	12,513	411	500	2894	3892	2823	1.831	1450	1950	1465	43.51	58.59	43.69
24		2.033	1.052	784	.7342	12,513	430	522	2818	3782	2821	1.801	1381	1853	1382	43.24	58.37	43.28
25		2.035	1.053	781	.7564	11,525	428	521	2286	3072	2297	1.398	948	1274	953	40.32	44.39	40.44
26		2.046	1.059	781	.7194	10,537	426	520	1646	2197	1654	1.121	479	639	481	38.03	46.91	35.07
27		2.038	1.057	785	.7397	9,220	430	525	893	1189	893	.8420	-49	-65	-48	28.21	37.80	28.21
28		2.032	1.055	782	.7386	7,903	429	525	486	651.2	488	.6928	-265	-355	-266	22.56	30.37	22.62
29		1.515	.786	784	.6098	12,513	431	482	1963	3526	1965	1.698	1123	2017	1124	33.77	58.56	33.84
30		1.521	.790	781	.6109	12,513	429	480	2017	3623	2027	1.704	1170	2101	1176	34.01	59.08	34.15
31		1.525	.794	781	.6127	11,525	431	482	1720	3077	1729	1.555	896	1605	900	32.80	56.71	33.00
32		1.519	.791	781	.6124	10,537	430	481	1259	2260	1265	1.304	532	955	536	29.08	50.40	29.23
33		1.513	.789	781	.6124	9,220	429	480	726	1305	730	1.030	157	282	158	22.87	39.63	22.96
34		1.512	.787	782	.6143	7,903	429	481	413	743	415	.8777	-40	-72	-40	18.21	31.56	18.28
35		1.528	.800	786	.6219	6,256	428	483	203	359	203	.7644	-150	-265	-150	13.99	23.87	13.94
36		1.221	.535	778	.5311	12,513	428	453	1528	3421	1542	1.789	1054	2360	1063	28.09	58.82	28.31
37		1.219	.533	781	.5305	12,513	431	454	1509	3371	1517	1.779	1031	2305	1036	28.38	59.37	28.56
38		1.224	.539	782	.5345	11,525	431	454	1324	2939	1329	1.652	848	1683	851	27.91	58.08	28.05
39		1.216	.531	788	.5362	10,537	431	453	1029	2282	1025	1.456	601	1333	599	25.51	52.98	25.44
40		1.217	.534	780	.5305	9,220	432	455	623	1392	827	1.188	293	655	295	18.52	40.91	19.68
41		1.216	.534	782	.5316	7,903	432	456	384	856	386	1.044	125	279	126	15.34	32.08	15.43
42		1.209	.528	784	.5299	6,256	433	457	194	433	194	.9452	3	7	3	11.39	23.85	11.45
43		1.064	.292	782	.4658	12,513	447	453	1245	3174	3174	1.841	1011	2577	1015	24.88	59.39	25.48
44		1.064	.297	784	.4655	12,513	449	455	1217	3091	3091	1.812	899	2537	1000	22.72	54.14	23.24
45		1.064	.292	782	.4682	11,525	446	452	1109	2827	2827	1.742	880	2243	884	24.35	58.05	24.89
46		1.060	.236	789	.4708	10,537	447	452	897	2275	2273	1.577	670	1698	667	24.72	58.59	25.09
47		1.059	.236	782	.4636	9,220	449	455	514	1515	1315	1.300	357	914	358	17.09	41.00	17.53
48		1.054	.276	785	.4621	7,903	449	457	334	856	858	1.166	214	548	215	13.39	32.15	13.72
49		1.053	.276	778	.4570	6,256	451	458	176	452	452	1.065	87	224	88	9.84	23.85	10.16
50	40,000	2.025	1.050	394	.4120	12,513	394	480	1513	4047	1505	1.898	786	2103	782	22.87	58.89	22.78
51		2.056	1.061	389	.4127	12,513	393	479	1502	4018	1514	1.699	766	2049	772	22.97	59.16	23.15
52		2.008	1.047	394	.4112	11,525	394	480	1327	3565	1320	1.560	625	1678	622	22.17	57.31	22.08
53		2.051	1.051	394	.4102	10,537	386	483	970	2592	965	1.258	362	941	350	19.40	50.01	19.38
54		2.036	1.057	393	.4149	9,220	394	481	561	1491	560	1.774	60	159	60	15.66	40.12	15.44
55		2.023	1.047	389	.4052	7,903	394	482	200	816	302	1.411	-108	-294	-108	12.89	33.78	15.01
56		2.015	1.071	391	.4166	6,256	394	484	128	337	128	1.129	-176	-463	-177	9.40	23.89	9.44
57		1.531	.797	397	.3398	12,513	402	452	1072	3958	1058	1.764	637	2235	628	17.88	58.61	17.85
58		1.534	.798	397	.3459	12,513	397	446	1079	3972	1065	1.778	643	2252	635	18.01	58.62	17.87
59		1.524	.792	401	.3466	11,525	399	447	981	3548	939	1.662	534	1865	522	17.72	57.55	17.46
60		1.526	.793	401	.3426	10,537	402	452	729	2642	713	1.394	349	1217	341	15.66	51.00	15.48
61		1.523	.786	396	.3369	9,220	405	455	398	1489	394	1.063	101	356	100	12.15	40.10	12.011
62		1.515	.790	398	.3369	7,903	405	455	255	992	251	.9067	28	98	28	9.37	30.98	9.387
63		1.508	.787	398	.3558	6,256	406	456	122	466	120	.7913	-52	-184	-51	7.21	23.87	7.217
64		1.222	.535	396	.2738	12,513	428	448	770	3681	762	1.827	527	2318	522	14.45	59.19	14.88
65		1.214	.526	401	.2750	12,513	428	450	779	3722	762	1.854	536	2339	524	14.59	59.41	14.90
66		1.207	.520	401	.2734	11,525	429	450	682	3235	676	1.716	463	2033	453	13.98	57.28	14.29
67		1.204	.516	402	.2734	10,537	429	450	529	2524	516	1.494	320	1405	312	12.65	52.65	13.09
68		1.202	.511	401	.2717	9,220	430	451	288	1427	291	1.252	146	645	143	9.40	38.76	9.618
69		1.199	.512	397	.2694	7,903	429	452	185	882	183	1.057	65	290	64	7.45	30.97	7.688
70		1.201	.518	394	.2680	6,256	430	452	78	465	79	.9598	-9	-40	-9	5.31	22.20	5.528
71	47,000	1.230	0.544	282	0.1951	12,513	428	451	587	3609	585	1.870	411	2521	410	10.28	58.89	10.49
72		1.206	.520	287	.1988	12,513	427	449	576	3784	564	1.872	407	2496	398	10.32	58.94	10.53
73		1.223	.536	287	.1987	11,525	426	449	521	3323	510	1.725	351	2128	344	10.10	57.02	10.29
74		1.220	.535	282	.1939	10,537	428	450	384	2565	388	1.520	240	1485	239	8.89	51.33	9.246
75		1.206	.524	282	.1928	9,220	428	451	228	1481	227	1.218	117	726	117	6.74	39.15	7.010
76		1.204	.522	280	.1905	7,903	430	453	126	917	127	1.080	41	257	41	5.17	30.33	5.429
77		1.207	.525	280	.1901	6,256	431	455	75	438	73	.9467	12	75	12	3.85	21.59	3.936
78	55,000	1.560	0.781	194	0.1656	12,563	400	448	557	4064	548	1.876	356	2598	350	8.44	57.28	8.38
79		1.538	.802	192	.1664	11,938	401	449	529	3820	526	1.771	318	2297	316	8.62	58.10	8.66
80		1.521	.802	192	.1644	11,563	402	450	495	3612	492	1.728	294	2145	292	8.50	54.52	8.56
81		1.531	.772	192	.1656	10,813	401	450	412	2986	410	1.534	225	1631	224	7.68	51.94	7.72
82		1.497	.798	185	.1624	10,313	403	450	336	2486	333	1.367	172	1273	170	6.96	48.00	6.97
83		1.531	.791	184	.1691	9,188	399	448	231	1681	227	1.095	94	672	93	5.61	37.36	5.57
84		1.181	.506	199	.1337	12,513	432	452	411	3689	394	1.958	297	2652	285	7.11	59.37	7.153
85		1.221	.536	190	.1307	12,438	427	451	426	3920	430	1.961	311	2849	313	6.92	59.15	7.25
86		1.201	.519	194	.1323	12,225	428	450	409	3715	405	1.910	295	2679	290	6.96	58.92	7.15
87		1.215	.526	191	.1307	12,063	423	451	399	3655	399	1.874	289	2647	289	6.83	56.87	6.92
88		1.206	.519	194	.1317	11,863	430	451	374	3597	368	1.803	285	2407	261	6.65	56.42	6.85
89		1.228	.543	189	.1323	11,250	423	447	362	3316	366	1.758	251	2299	254	6.54	55.66	6.85
90		1.300	.619	190	.1402	10,938	417	449	343	2860	345	1.577	219	1684	220	6.42	51.37	6.64

[redacted]

2470

SIMULATED-FLIGHT CONDITIONS WITH MIXER VANES INSTALLED - Continued

Engine total-temperature ratio $\frac{T_5}{T_2}$	Fuel flow, (lb/hr) Altitude W_f	Corrected $\frac{W_f}{\delta_T\sqrt{\theta_T}}$	Adjusted $\frac{W_f}{\delta_{adj}\sqrt{\theta_{adj}}}$	Turbine-outlet total pressure P_5 $\left(\frac{lb}{sq\ ft\ abs.}\right)$	Specific fuel consumption $\frac{lb/hr}{lb}$ Altitude $\frac{W_f}{F_n}$	Corrected $\frac{W_f}{F_n\sqrt{\theta_T}}$	Adjusted $\frac{W_f}{F_n\sqrt{\theta_{adj}}}$	Exhaust gas total temperature, (°R) Altitude T_8	Corrected $\frac{T_8}{\theta_T}$	Adjusted $\frac{T_8}{\theta_{adj}}$	Corrected engine speed $\frac{N}{\sqrt{\theta_T}}$ (rpm)	Adjusted engine speed $\frac{N}{\sqrt{\theta_{adj}}}$ (rpm)	Run
(c) Exhaust-nozzle area, 192 square inches.													
3.015	2815	3140	2730	3335	1.188	1.248	1.238	1411	1566	1533.7	13,176	13,051	1
3.023	2825	3143	2752	3343	1.190	1.251	1.242	1116	1570	1541.3	13,164	13,051	2
2.764	2195	2629	2292	3138	1.174	1.237	1.228	1291	1434	1405.9	12,147	12,032	3
2.533	1730	2075	1813	2781	1.270	1.337	1.327	1183	1514	1291.8	11,106	11,011	4
2.423	1331	1595	1385	2363	1.780	1.873	1.853	1139	1259	1232.4	9,690	9,589	5
2.368	1095	1514	1142	2122	2.800	2.944	2.913	1113	1230	1204.3	8,306	8,219	6
2.354	866	1031	897	1959	5.410	5.704	5.613	1111	1222	1207.6	6,563	6,494	7
2.777	2248	2747	2245	2951	1.368	1.378	1.364	1422	1442	1414	12,601	12,474	8
2.810	2276	2801	2289	2981	1.347	1.365	1.351	1422	1459	1430	12,676	12,551	9
2.527	1822	2226	1824	2693	1.411	1.424	1.410	1289	1312	1286	11,629	11,512	10
2.273	1387	1694	1386	2324	1.669	1.684	1.667	1159	1180	1156	10,632	10,525	11
2.114	1098	1341	1100	1975	2.89	2.916	2.887	1078	1097	1076	9,303	9,210	12
2.002	917	1121	920	1777	69.0	6.962	6.895	1019	1039	1019	7,382	7,903	13
1.871	720	875	718	1633	-72.0	-72.40	-71.70	960	972	952	6,294	6,250	14
3.072	2275	2926	2393	2974	1.327	1.409	1.394	1413	1595	1560	13,288	13,151	15
2.761	2260	2766	2265	2958	1.325	1.336	1.323	1408	1433	1405	12,626	12,499	16
2.509	1827	2227	1825	2691	1.369	1.380	1.366	1282	1303	1277	11,617	11,501	17
2.262	1396	1709	1398	2352	1.670	1.688	1.671	1149	1174	1150	10,653	10,548	18
2.100	1090	1330	1090	1960	3.070	3.093	3.062	1078	1090	1069	9,285	9,191	19
1.982	915	1114	915	1772	7.32	7.376	7.312	1013	1029	1011	7,966	7,894	20
1.845	716	874	718	1629	-2.047	-20.63	-20.43	943	958	941	6,306	6,249	21
2.805	1892	2534	1898	2534	1.378	1.374	1.381	1360	1352	1367	12,477	12,538	22
2.686	1923	2628	1987	2565	1.327	1.348	1.337	1361	1394	1413	12,713	12,801	23
2.613	1867	2491	1869	2524	1.352	1.344	1.352	1372	1356	1372	12,442	12,513	24
2.285	1412	1891	1422	2202	1.490	1.484	1.483	1195	1186	1201	11,481	11,548	25
1.885	1060	1411	1069	1776	2.212	2.207	2.221	984	978	993	10,506	10,579	26
1.463	753	9963	753	1338	-15.37	-15.27	-15.37	780	770	780	9,158	9,220	27
1.214	570	7598	573	1094	-2.151	-2.14	-2.155	636	630	637	7,865	7,911	28
2.851	1557	2893	1557	2001	1.387	1.455	1.385	1380	1478	1376.8	12,951	12,498	29
2.863	1572	2931	1582	2007	1.344	1.395	1.345	1380	1486	1382.8	12,988	12,526	30
2.546	1300	2404	1304	1840	1.451	1.500	1.449	1235	1320	1232.1	11,917	11,511	31
2.190	1040	1931	1045	1538	1.955	2.023	1.955	1060	1135	1060	10,906	10,537	32
1.867	818	1527	823	1212	5.21	5.408	5.217	900	969	901.6	9,570	9,229	33
1.622	664	1239	668	1033	-16.6	-17.23	-16.63	782	842	783.6	8,203	7,911	34
1.379	520	953	520	915	-3.467	-3.593	-3.473	666	716	669.3	6,487	6,269	35
3.089	1370	3280	1383	1691	1.300	1.391	1.301	1407	1608	1409.8	13,376	12,526	36
3.075	1373	3275	1378	1685	1.332	1.422	1.330	1399	1596	1395.8	13,364	12,998	37
2.765	1180	2735	1184	1584	1.392	1.488	1.390	1261	1435	1258.1	12,297	11,511	38
2.481	1001	2371	986	1399	1.665	1.762	1.664	1129	1288	1126.4	11,254	10,524	39
2.187	807	1921	810	1125	2.753	2.955	2.747	1004	1141	994.5	9,829	9,199	40
2.079	682	1621	683	991	5.46	6.058	5.440	950	1079	945.6	8,425	7,885	41
1.976	544	1295	543	897	181.5	193.3	180.7	904	1027	897.7	6,689	6,234	42
3.186	1280	3494	1260	1526	1.266	1.352	1.241	1454	1659	1398.8	13,384	12,273	43
3.179	1287	3485	1260	1509	1.289	1.375	1.260	1463	1651	1391.5	13,339	12,245	44
2.894	1107	3015	1091	1446	1.258	1.344	1.235	1314	1502	1266.8	12,320	11,316	45
2.656	960	2600	937	1317	1.091	1.531	1.406	1206	1378	1160.2	11,264	10,335	46
2.504	776	2119	762	1075	2.173	2.326	2.126	1142	1300	1093.7	9,838	9,023	47
2.461	678	1852	665	963	3.170	3.363	3.098	1122	1277	1074.5	8,433	7,734	48
2.489	554	1520	546	875	6.370	6.475	6.218	1140	1290	1088.9	6,656	6,108	49
2.884	1090	3031	1083	1343	1.387	1.441	1.385	1387	1498	1383.5	13,001	12,497	50
2.886	1094	3041	1103	1344	1.428	1.484	1.428	1388	1499	1388	13,001	12,513	51
2.590	940	2623	934	1229	1.505	1.563	1.502	1246	1346	1242.9	11,974	11,510	52
2.157	766	2122	759	1004	2.176	2.256	2.168	1042	1120	1034.1	10,927	10,497	53
1.693	592	1632	580	733	9.87	10.25	9.850	816	879	813.9	9,570	9,208	54
1.374	475	1344	478	575	———	-4.574	-4.389	681	714	659.3	8,211	7,893	55
———	336	912	337	485	———	-1.972	-1.909	———	———	———	6,469	6,248	56
3.093	942	3541	919	1076	1.479	1.584	1.462	1401	1607	1370	13,401	12,372	57
3.129	954	3598	937	1074	1.483	1.597	1.476	1402	1624	1386	13,484	12,449	58
2.780	850	3192	825	1007	1.59	1.712	1.581	1248	1443	1229	12,389	11,439	59
2.391	750	2799	725	846	2.15	2.301	2.126	1083	1242	1059	11,285	10,418	60
1.947	611	2296	596	639	6.05	6.455	5.860	888	1011	861.7	9,835	9,083	61
1.757	522	1965	506	544	1.863	19.89	18.36	801	912	777.3	8,433	7,785	62
1.471	429	1618	416	474	———	-8.808	-8.115	671	764	649.6	6,675	6,165	63
3.244	829	3915	786	879	1.574	1.689	1.610	1460	1683	1348	13,459	12,019	64
3.249	830	3879	777	899	1.549	1.659	1.483	1464	1679	1345	13,401	11,990	65
2.918	749	3521	701	828	1.616	1.732	1.549	1319	1513	1208	12,343	11,031	66
2.602	684	3216	639	720	2.139	2.291	2.047	1176	1349	1077	11,285	10,085	67
2.338	585	2770	546	590	4.016	4.295	3.829	1057	1212	966	9,875	8,814	68
2.206	525	2504	497	507	8.076	8.646	7.723	997	1144	913	8,464	7,564	69
2.068	446	2139	424	454	-49.55	-53.11	-47.33	937	1075	856	6,700	5,981	70
3.340	669	4591	639	645	1.626	1.742	1.560	1513	1735	1389	13,401	11,990	71
3.389	672	4628	652	646	1.655	1.774	1.585	1516	1748	1395	13,439	12,005	72
3.009	622	4050	585	602	1.774	1.903	1.701	1354	1561	1249	12,378	11,070	73
2.668	570	3774	544	520	2.375	2.542	2.275	1206	1383	1107	11,285	10,097	74
2.423	498	3317	475	414	3.404	4.356	4.077	1095	1256	1005	9,875	8,833	75
2.296	453	3045	435	364	11.05	11.83	10.56	1040	1193	950.6	8,464	7,555	76
2.079	407	2723	391	320	1.394	36.25	32.42	946	1079	862.6	6,881	5,974	77
3.445	601	4714	587	544	1.669	1.815	1.674	1.547	1768	1520	13,506	12,462	78
3.151	578	4470	569	519	1.818	1.947	1.799	1415	1623	1387	12,786	11,817	79
3.029	550	4238	541	501	1.871	2.003	1.850	1369	1570	1338	12,384	11,432	80
2.717	517	4018	509	448	2.30	2.462	2.276	1228	1409	1203	11,581	10,704	81
2.541	485	3847	476	391	2.82	3.023	2.785	1146	1319	1117	11,066	10,184	82
2.167	432	3317	422	324	4.598	4.936	4.564	975	1124	960.4	9,868	9,119	83
3.590	539	5143	493	464	1.815	1.939	1.731	1630	1863	1483	13,376	11,935	84
3.650	530	5205	511	453	1.705	1.826	1.633	1650	1893	1518.6	13,321	11,933	85
3.512	527	5151	497	445	1.787	1.947	1.712	1584	1823	1454	13,117	11,714	86
3.434	507	4974	486	433	1.755	1.879	1.682	1552	1780	1425	12,919	11,559	87
3.230	493	4795	464	420	1.861	1.992	1.777	1465	1678	1337	12,384	11,054	88
3.143	482	4764	470	408	1.920	2.068	1.853	1408	1780	1308	12,105	10,844	89
3.129	476	4404	464	388	2.174	2.338	2.110	1405	1624	1324	11,758	10,619	90

TABLE I. - PERFORMANCE AT VARIOUS ENGINE-OPERATING AND

Run	Altitude (ft)	Ram pressure ratio $\frac{P_1}{p_0}$	Flight Mach number M_0	Tunnel static pressure p_0 $\left(\frac{lb}{sq\ ft\ abs.}\right)$	Reynolds number index $\frac{\delta_T}{\phi\sqrt{\theta_T}}$	Engine speed N (rpm)	Equivalent ambient air temperature t (°R)	Engine-inlet indicated temperature T_i (°R)	Jet thrust, (lb): Altitude F_j	Jet thrust: Corrected $\frac{F_j}{\delta_T}$	Jet thrust: Adjusted $\frac{F_j}{\delta_{adj}}$	Engine total-pressure ratio $\frac{P_5}{P_2}$	Net thrust, (lb): Altitude F_n	Net thrust: Corrected $\frac{F_n}{\delta_T}$	Net thrust: Adjusted $\frac{F_n}{\delta_{adj}}$	Air flow, (lb/sec): Altitude W_a	Air flow: Corrected $\frac{W_a\sqrt{\theta_T}}{\delta_T}$	Air flow: Adjusted $\frac{W_a\sqrt{\theta_{adj}}}{\delta_{adj}}$
(d) Exhaust-nozzle area, 274 square inches.																		
1	5,000	1.060	0.278	1756	0.9860	12,513	463	468	1687	1927	1692	1.369	1190	1359	1194	54.66	59.42	52.71
2		1.061	.280	1755	.9823	12,513	468	473	1692	1932	1697	1.365	1192	1361	1196	54.13	59.16	52.46
3		1.058	.278	1756	1.007	11,525	460	465	1491	1703	1495	1.310	1007	1150	1010	53.37	57.80	51.27
4		1.059	.280	1753	1.000	10,537	462	467	1160	1328	1166	1.225	718	821	722	48.14	52.33	46.47
5		1.055	.273	1757	.9860	9,220	463	469	724	828	725	1.124	385	452	396	36.82	40.10	35.47
6		1.054	.273	1759	1.012	7,903	458	465	465	531	465	1.063	201	230	201	29.72	32.13	28.44
7		1.054	.276	1757	1.005	6,256	461	467	280	320	281	1.022	75	86	75	22.72	24.65	21.83
8		1.069	.303	1756	1.009	12,513	462	467	1702	1923	1707	1.353	1148	1297	1151	55.74	59.92	53.71
9	10,000	1.208	0.527	1459	0.8584	12,513	481	505	1631	1957	1628	1.264	758	910	756	49.61	58.89	49.41
10		1.204	.522	1456	.8424	12,513	486	510	1606	1938	1606	1.261	746	900	746	45.08	58.80	49.23
11		1.211	.531	1450	.8584	11,525	479	503	1573	1654	1378	1.182	542	653	544	46.98	55.91	46.98
12		1.209	.528	1447	.8532	10,537	481	505	1018	1231	1024	1.087	294	355	298	40.98	49.01	41.14
13		1.206	.524	1452	.8554	9,220	481	505	628	759	630	.9937	58	82	68	32.02	38.26	32.05
14		1.210	.529	1450	.8460	7,903	485	510	393	474	395	.9288	-57	-69	-57	25.35	30.37	25.50
15		1.205	.524	1456	.8489	6,256	484	509	203	245	203	.8908	-135	-163	-136	19.27	23.08	19.29
16	25,000	1.513	0.793	781	0.6101	12,513	431	483	1328	2374	1333	1.212	469	840	471	34.18	59.13	34.39
17		1.504	.787	783	.6098	12,513	431	482	1337	2401	1341	1.214	493	885	494	33.92	58.82	34.08
18		1.507	.789	783	.6127	11,525	430	481	1150	2026	1153	1.114	310	556	311	32.91	57.00	33.01
19		1.508	.790	781	.6090	10,537	451	483	814	1462	818	.9813	85	153	85	29.19	50.67	29.37
20		1.508	.790	782	.6128	9,220	429	482	475	849	475	.8473	-110	-197	-110	23.40	40.53	23.47
21		1.499	.783	784	.6064	7,903	432	485	265	477	265	.7804	-193	-348	-193	18.45	32.12	18.51
22		1.515	.794	786	.6162	6,256	430	486	135	240	135	.7254	-237	-421	-237	14.84	25.47	14.82
23		1.220	.534	786	.5338	12,513	431	454	945	2096	944	1.314	460	1020	459	28.71	59.69	28.76
24		1.210	.524	780	.5291	12,513	430	452	945	2127	951	1.312	478	1078	481	28.21	59.38	28.38
25		1.216	.529	786	.5394	11,525	428	450	830	1847	829	1.247	363	808	363	27.99	58.11	27.90
26		1.216	.529	781	.5336	10,537	430	451	637	1426	640	1.150	212	475	213	28.40	53.19	25.53
27		1.211	.528	781	.5316	9,220	431	453	378	847	380	1.028	42	94	42	20.15	42.25	20.25
28		1.214	.532	782	.5330	7,903	431	455	218	489	220	.9420	-44	-98	-44	15.63	32.67	15.71
29		1.204	.522	783	.5302	6,256	431	455	129	289	129	.8982	-65	-146	-65	11.74	24.67	11.78
30		1.069	.303	785	.4773	12,513	442	447	771	1949	771	1.388	523	1322	523	25.47	59.96	25.83
31		1.063	.290	782	.4675	12,513	446	451	781	1993	784	1.392	549	1401	551	24.87	59.36	25.42
32		1.066	.302	786	.4748	11,525	444	450	710	1795	709	1.332	469	1186	468	24.85	58.62	25.22
33		1.065	.303	784	.4748	10,537	444	449	554	1402	556	1.250	328	830	328	23.17	54.73	23.58
34		1.058	.288	781	.4735	9,220	442	447	331	848	333	1.134	171	438	172	17.55	41.82	17.82
35		1.052	.270	785	.4726	7,930	443	449	215	551	215	1.064	98	251	98	13.49	32.15	13.69
36		1.052	.273	786	.4721	6,256	443	450	112	286	112	1.018	21	54	21	10.37	24.68	10.52
37	40,000	2.064	1.066	393	0.4241	12,513	389	475	1128	2969	1126	1.198	384	1011	383	23.23	58.61	23.08
38		1.995	1.020	396	.4023	12,513	396	477	1033	2850	1023	1.236	413	1139	409	20.06	53.18	19.94
39		2.056	1.064	390	.4195	11,525	390	476	980	2605	985	1.095	258	686	259	22.56	57.55	22.58
40		2.026	1.051	390	.4092	10,537	394	480	679	1833	682	.9349	59	159	59	19.51	50.89	19.83
41		2.036	1.058	391	.4105	9,220	395	483	352	941	353	.7121	-151	-403	-151	15.71	40.53	15.80
42		2.049	1.063	389	.4182	9,220	389	477	367	979	370	.7150	-145	-387	-146	16.01	40.95	16.08
43		1.530	.798	394	.3361	12,513	402	451	724	2558	720	1.265	291	1028	230	17.76	58.63	17.87
44		1.525	.794	396	.3422	12,513	400	447	733	2585	726	1.277	297	1048	294	18.01	59.14	17.99
45		1.536	.806	394	.3416	11,526	401	451	631	2210	628	1.176	190	666	189	17.92	58.65	18.01
46		1.530	.800	394	.3403	10,537	401	450	497	1753	494	1.057	100	353	99	16.27	53.54	16.35
47		1.528	.800	392	.3383	9,220	402	452	270	957	270	.8784	-39	-138	-39	12.63	41.82	12.77
48		1.527	.800	395	.3438	7,903	398	449	150	527	149	.7973	-93	-327	-92	9.89	32.66	9.97
49		1.240	.558	391	------	12,513	---	450	----	----	----	------	----	----	----	-----	-----	-----
50		1.208	.521	389	.2645	12,513	429	450	477	2157	481	1.350	247	1117	249	14.01	59.11	14.75
51		1.212	.528	387	.2662	11,525	427	449	425	1921	431	1.271	194	877	197	13.90	58.57	14.68
52		1.205	.521	388	.2643	10,537	431	452	338	1533	342	1.179	129	585	130	12.73	53.82	13.43
53		1.208	.524	389	.2657	9,220	429	452	205	925	207	1.048	41	185	41	9.93	41.85	10.46
54		1.208	.531	389	------	7,903	---	454	----	----	----	------	----	----	----	-----	-----	-----
55		1.199	.522	392	------	6,256	---	453	----	----	----	------	----	----	----	-----	-----	-----
56	47,000	1.212	0.552	283	0.1956	12,513	426	448	350	2189	348	1.341	176	1086	175	10.28	59.63	10.73
57		1.229	.547	275	.1920	11,525	426	448	326	2047	333	1.285	154	967	157	10.35	58.66	10.86
58		1.225	.542	280	.1968	12,500	422	445	392	2426	394	1.365	218	1349	219	10.45	58.86	10.66
59		1.236	.556	277	.1955	12,500	424	447	395	2444	401	1.342	214	1324	217	9.87	59.63	10.91
60		1.218	.539	284	.1983	12,000	424	446	361	2208	357	1.329	184	1125	182	9.00	59.44	10.74
61		1.213	.528	282	.1974	11,313	421	443	338	2097	337	1.279	175	1086	174	8.50	56.71	10.18
62		1.209	.524	282	.1929	10,688	429	449	259	1612	258	1.203	110	685	110	6.32	52.33	9.369
63		1.213	.538	286	.2006	9,938	423	445	212	1289	208	1.115	69	420	68	4.82	47.97	8.662
64		1.218	.539	280	.1969	8,500	422	445	140	869	141	.9677	33	205	33	10.38	36.35	6.573
65		1.221	.547	280	.1958	6,875	425	450	75	463	75	.8038	-8	-49	-8	10.02	27.69	5.032
66	55,000	1.517	.789	201	0.1956	12,513	----	445	----	----	----	------	----	----	----	-----	-----	-----
67		1.528	.796	199	.1735	12,019	398	446	386	2705	370	1.268	167	1170	160	9.04	58.85	8.729
68		1.523	.793	199	.1692	11,625	404	453	339	2383	325	1.213	130	914	125	8.59	56.54	8.360
69		1.536	.806	197	.1696	11,088	404	453	303	2123	294	1.166	95	666	92	8.42	55.30	8.276
70		1.533	.808	197	.1693	10,537	404	454	249	1745	241	1.050	56	392	54	7.82	51.36	7.688
71		1.526	.800	197	.1702	9,313	401	451	160	1128	156	.8700	16	113	16	5.89	38.77	5.767
72		1.219	.539	199	.1334	12,513	433	455	273	2417	266	1.372	153	1355	149	6.99	58.14	7.151
73		1.201	.519	197	.1337	12,019	425	446	262	2379	258	1.348	151	1371	149	6.82	57.65	6.964
74		1.206	.531	202	.1351	11,525	432	454	232	2037	223	1.296	116	1018	111	6.89	56.70	6.931
75		1.206	.524	202	.1340	11,000	434	455	223	1966	214	1.263	114	1005	109	6.57	54.42	6.829
76		1.219	.545	203	.1381	10,537	429	454	171	1471	162	1.154	61	525	58	6.37	51.30	6.326
77		1.237	.565	201	.1394	9,220	426	451	129	1100	124	.9837	42	361	41	4.87	39.14	4.859

2470

SIMULATED-FLIGHT CONDITIONS WITH MIXER VANES INSTALLED - Continued

Engine total-temperature ratio $\frac{T_5}{T_2}$	Fuel flow, (lb/hr) Altitude W_f	Fuel flow, (lb/hr) Corrected $\frac{W_f}{\delta_T\sqrt{\theta_T}}$	Fuel flow, (lb/hr) Adjusted $\frac{W_f}{\delta_{adj}\sqrt{\theta_{adj}}}$	Turbine-outlet total pressure P_5 $\left(\frac{lb}{sq\ ft\ abs.}\right)$	Specific fuel consumption $\frac{lb/hr}{lb}$ Altitude $\frac{W_f}{F_n}$	Specific fuel consumption Corrected $\frac{W_f}{F_n\sqrt{\theta_T}}$	Specific fuel consumption Adjusted $\frac{W_f}{F_n\sqrt{\theta_{adj}}}$	Exhaust gas total temperature, (°R) Altitude T_8	Exhaust gas total temperature Corrected $\frac{T_8}{\theta_T}$	Exhaust gas total temperature Adjusted $\frac{T_8}{\theta_{adj}}$	Corrected engine speed $\frac{N}{\sqrt{\theta_T}}$ (rpm)	Adjusted engine speed $\frac{N}{\sqrt{\theta_{adj}}}$ (rpm)	Run
(d) Exhaust-nozzle area, 274 square inches.													
2.326	1774	2129	1851	2537	1.491	1.666	1.550	1093	1208	1183	13,161	13,014	1
2.316	1770	2113	1837	2529	1.485	1.552	1.537	1100	1201	1178	13,076	12,951	2
2.161	1592	1918	1667	2427	1.581	1.666	1.650	1009	1121	1099	12,147	12,032	3
2.036	1395	1678	1459	2268	1.942	2.045	2.022	965	1057	1035	11,085	10,969	4
2.030	1202	1445	1253	2079	3.045	3.197	3.165	954	1054	1032	9,690	9,589	5
2.080	1064	1284	1114	1969	5.29	5.592	5.557	972	1084	1064	8,346	8,267	6
2.143	918	1105	959	1892	12.24	12.89	12.76	1003	1112	1090	6,588	6,525	7
2.302	1767	2098	1845	2532	1.54	1.818	1.602	1082	1196	1173	13,151	13,026	8
2.144	1520	1844	1520	2229	2.008	2.028	2.009	1089	1113	1094	12,651	12,538	9
2.125	1514	1838	1509	2211	2.030	2.042	2.023	1030	1103	1084	12,588	12,474	10
1.960	1341	1636	1351	2078	2.474	2.506	2.483	992	1018	1000	11,675	11,571	11
1.833	1174	1435	1183	1902	3.994	4.037	4.000	931	951	934	10,653	10,558	12
1.806	1002	1226	1007	1739	14.73	14.91	14.76	915	937	919	9,331	9,238	13
1.781	846	1028	847	1630	-14.85	-14.95	-14.81	912	925	908	7,958	7,886	14
1.735	721	876.8	720	1563	-5.344	-5.385	-5.333	885	901	885	6,312	6,249	15
2.171	1146	2119	1150	1432	2.442	2.525	2.439	1053	1126	1051	12,938	12,498	16
2.184	1154	2144	1156	1430	2.340	2.422	2.339	1057	1132	1055	12,951	12,498	17
1.921	1038	1926	1041	1514	3.348	3.465	3.348	930	996	1057	11,928	11,525	18
1.669	873	1633	882	1156	1.035	10.69	10.33	819	876	817	10,895	10,524	19
1.507	705	1312	709	999	-6.412	-6.645	-6.416	728	783	729.5	9,561	9,229	20
1.427	625	1163	625	917	-3.239	-3.347	-3.233	692	740	688.8	8,172	7,885	21
1.289	529	974	528	864	-2.252	-2.312	-2.252	624	668	624	6,475	6,256	22
2.320	1039	2460	1057	1254	2.258	2.411	2.257	1058	1204	1056	13,351	12,498	23
2.330	1036	2492	1042	1233	2.167	2.316	2.167	1058	1209	1058	13,376	12,513	24
2.091	980	2336	981	1186	2.700	2.893	2.705	945	1084	950	12,343	11,648	25
1.914	890	2129	894	1087	4.200	4.486	4.198	869	993	869	11,264	10,537	26
1.802	769	1841	772	968	18.32	19.55	18.29	820	938	818	9,847	9,209	27
1.809	683	1627	685	893	-15.54	-16.57	-15.50	823	938	821	8,440	7,894	28
1.802	587	1407	588	847	-9.03	-9.646	-9.015	820	935	818	6,681	6,248	29
2.444	984	2672	971	1160	1.882	2.021	1.857	1100	1268	1070	13,439	12,343	30
2.436	974	2657	960	1154	1.775	1.896	1.741	1106	1264	1066	13,376	12,287	31
2.228	932	2523	918	1115	1.987	2.128	1.955	1007	1155	978.3	12,343	11,342	32
2.082	870	2359	857	1045	2.653	2.841	2.610	941	1079	911.4	11,285	10,369	33
2.069	772	2128	766	937	4.515	4.854	4.456	929	1074	905.8	9,912	9,905	34
2.134	697	1919	687	878	7.12	7.643	7.010	958	1107	929.9	8,496	7,788	35
2.227	613	1682	603	843	29.20	31.33	28.76	1002	1155	972.6	6,719	6,163	36
2.249	884	2427	888	963	2.3	2.401	2.313	1073	1167	1083.7	13,051	12,576	37
2.246	859	2467	847	948	2.08	2.165	2.073	1076	1166	1068	13,026	12,465	38
1.975	803	2225	810	872	3.11	3.244	3.124	944	1025	951.5	12,009	11,571	39
1.692	675	1892	677	733	11.44	11.88	11.48	814	879	812	10,948	10,525	40
1.310	503	1382	504	564	-3.331	-3.450	-3.325	634	679	630.7	9,543	9,196	41
1.331	503	1401	510	567	-3.47	-3.621	-3.490	635	691	641.3	9,616	9,266	42
2.371	778	2943	768	758	2.67	2.863	2.643	1074	1232	1050	13,401	12,372	43
2.380	775	2934	760	766	2.61	2.801	2.586	1071	1235	1052	13,439	12,403	44
2.075	732	2746	721	710	3.85	4.126	3.816	940	1078	921.2	12,343	11,409	45
1.828	650	2455	640	634	6.50	6.960	6.430	825	946	808.5	11,285	10,431	46
1.583	556	2109	550	525	-14.26	-15.26	-14.10	717	822	700.9	9,878	9,116	47
1.497	503	1902	496	480	-5.41	-5.817	-5.376	672	777	663.5	8,496	7,853	48
-----	686	----	----	----	------	------	------	----	----	-----	------	------	49
2.487	667	3228	643	632	2.70	2.891	2.583	1115	1279	1022	13,401	11,976	50
2.217	642	3116	624	595	3.312	3.552	3.175	1000	1151	920	12,366	11,057	51
2.020	602	2912	580	552	4.67	4.992	4.457	917	1048	836	11,264	10,062	52
1.938	538	2589	519	492	13.13	14.05	12.56	878	1007	804	9,875	8,824	53
-----	510	----	----	----	------	------	------	----	----	-----	------	------	54
-----	470	----	----	----	------	------	------	----	----	-----	------	------	55
2.538	556	3883	530	460	3.16	3.392	3.034	1141	1316	1052.6	13,439	12,019	56
2.337	548	3692	538	433	3.56	3.819	3.416	1054	1213	972.3	12,366	11,070	57
2.541	564	3756	546	467	2.58	2.784	2.495	1136	1318	1057.9	13,463	12,063	58
2.549	564	3749	551	459	2.83	2.832	2.537	1147	1322	1063	13,425	12,035	59
2.421	564	3645	527	460	3.01	3.259	2.897	1087	1257	1007.5	12,300	11,654	60
2.252	550	3686	529	436	3.14	3.394	3.034	1002	1168	935.4	12,218	10,931	61
2.110	513	3417	489	409	4.67	4.991	4.464	956	1097	875.8	11,447	10,229	62
2.027	487	3186	461	388	7.05	7.594	6.797	906	1051	841.7	10,703	9,579	63
1.991	450	3016	436	330	13.6	14.73	13.15	888	1034	827	9,172	8,203	64
1.927	431	2856	416	310	------	-67.88	-51.75	867	1000	801.7	7,384	6,011	65
-----	520	----	----	----	------	------	------	----	----	-----	------	------	66
2.400	509	3840	486	383	3.05	3.281	3.030	1075	1245	1081.4	12,932	11,943	67
2.282	497	3733	470	365	3.825	4.085	3.769	1029	1174	1001	12,416	11,466	68
2.121	472	3532	452	349	4.970	5.305	4.905	967	1100	940.7	11,831	10,938	69
1.938	431	3223	412	317	7.695	8.214	7.589	883	1005	859	11,243	10,393	70
1.737	396	2990	380	361	24.75	26.50	24.50	785	900	769	9,974	9,219	71
2.627	417	3931	387	328	2.726	2.902	2.585	1203	1362	1092	13,314	11,921	72
2.538	451	4405	427	314	2.987	3.212	2.874	1136	1315	1050.5	12,932	11,557	73
2.346	422	3951	387	312	3.640	3.879	3.474	1070	1218	973.4	12,297	10,993	74
2.253	424	3976	387	303	3.720	3.956	3.535	1032	1168	934.5	11,704	10,468	75
2.167	391	3596	355	294	6.412	6.852	6.131	986	1125	903.3	11,264	10,085	76
2.102	378	3484	360	242	9.000	9.643	8.643	952	1092	878.2	9,875	8,856	77

TABLE I. - PERFORMANCE AT VARIOUS ENGINE-OPERATING AND

Run	Nozzle area (sq in.)	Altitude (ft)	Ram pressure ratio $\frac{P_1}{p_0}$	Flight Mach number M_0	Tunnel static pressure p_0 $\left(\frac{lb}{sq\ ft\ abs.}\right)$	Reynolds number index $\frac{\delta_T}{\varphi\sqrt{\theta_T}}$	Engine speed N (rpm)	Equivalent ambient air temperature t (°R)	Engine-inlet indicated temperature T_i (°R)	Jet thrust, (lb): Altitude F_j	Jet thrust, (lb): Corrected $\frac{F_j}{\delta_T}$	Jet thrust, (lb): Adjusted $\frac{F_j}{\delta_{adj}}$	Engine total-pressure ratio $\frac{P_5}{P_2}$	Net thrust, (lb): Altitude F_n	Net thrust, (lb): Corrected $\frac{F_n}{\delta_T}$	Net thrust, (lb): Adjusted $\frac{F_n}{\delta_{adj}}$	Air flow, (lb/sec): Altitude W_a	Air flow, (lb/sec): Corrected $\frac{W_a\sqrt{\theta_T}}{\delta_T}$	Air flow, (lb/sec): Adjusted $\frac{W_a\sqrt{\theta_{adj}}}{\delta_{adj}}$
(e) Miscellaneous points, exhaust-nozzle area given.																			
1	158.5	25,000	1.069	0.299	780	0.4658	10,775	447	454	1226	3125	1253	1.943	1012	2580	1018	22.17	52.92	22.75
2	161.5		1.065	.286	787	.4695	10,600	446	453	1052	2672	1049	1.783	852	2164	850	21.77	51.66	22.10
3	154.3		1.060	.278	785	.4728	9,938	442	449	829	2119	829	1.650	670	1713	670	17.93	42.62	18.18
4	157.5	40,000	1.545	0.803	396	0.3434	12,125	400	449	1304	4561	1291	2.209	862	3015	853	18.05	58.89	18.04
5	154.9		1.520	.786	396	.3375	11,825	402	450	1236	4595	1224	2.118	819	2912	811	17.35	57.57	17.37
6	154.3		1.537	.814	391	.3400	11,188	401	455	1159	4060	1162	2.098	740	2592	742	16.87	55.27	17.08
7	154.3		1.548	.806	398	.3439	10,625	399	461	865	3016	856	1.707	500	1743	496	14.86	48.30	14.83
8	157.5		1.220	.525	391	.2690	11,900	428	448	940	4214	943	2.222	709	3178	711	13.89	58.34	14.61
9	-----		1.216	.522	393	.2698	11,775	427	448	881	3942	879	2.112	651	2913	649	14.01	58.37	14.58
10	157.5		1.224	.532	392	.2700	11,725	426	449	915	4076	915	2.179	680	3029	680	14.07	58.36	14.65
11	156.5		1.220	.525	387	.2664	11,563	428	448	899	4075	911	2.186	673	3049	682	13.83	57.69	14.40
12	159.2		1.218	.527	394	.2718	10,938	425	448	735	3267	731	1.814	518	2303	515	13.10	54.16	13.58
13	159.1		1.221	.531	394	.2700	10,613	428	451	594	2635	591	1.688	400	1774	399	11.89	47.98	12.04
14	167.6	47,000	1.225	0.529	271	0.1856	11,100	429	451	499	3219	517	1.826	349	2251	362	9.00	54.18	9.75
15	173.1		1.213	.515	268	.1842	11,025	425	446	467	3078	490	1.773	323	2129	339	8.93	54.70	9.74
16	179.2		1.229	.534	271	.1886	10,475	426	450	346	2226	359	1.617	213	1370	221	7.88	47.30	8.53
17	163.9		1.225	.535	275	.1902	9,688	426	450	286	1812	292	1.407	169	1071	173	6.95	41.00	7.39
18	159.8		1.230	.536	269	.1855	9,313	427	451	255	1650	266	1.355	151	977	156	6.19	37.38	6.74
19	175.2	55,000	1.508	0.775	195	0.1678	11,850	398	445	536	3911	525	1.879	358	2430	326	8.65	58.38	8.61
20	165.3		1.556	.808	186	.1712	11,250	399	449	535	3761	521	1.874	327	2299	319	8.44	55.31	8.28
21	176.2		1.589	.832	192	.1722	10,750	395	448	447	3132	445	1.593	245	1717	244	8.02	52.33	8.00
22	166.8		1.659	.815	195	.1729	10,375	395	446	365	2566	356	1.508	188	1322	184	7.19	46.91	7.08
23	160.6		1.582	.828	194	.1724	9,500	398	451	285	1984	281	1.318	129	898	127	6.18	40.16	6.12
24	197.6		1.236	.535	191	.1313	12,625	428	450	361	3293	361	1.784	247	2253	247	6.79	57.80	7.04
25	202.8		1.258	.565	190	.1345	12,625	422	448	355	3183	357	1.669	229	2053	230	7.15	59.82	7.44
26	183.3		1.256	.541	191	.1319	12,438	427	450	438	3978	438	1.891	320	2906	320	6.95	58.90	7.24
27	202.8		1.252	.536	190	.1312	12,125	426	449	327	2985	329	1.645	210	1924	211	6.93	59.18	7.25
28	183.3		1.253	.555	190	.1326	12,063	425	450	415	3753	417	1.923	296	2677	297	6.83	57.58	7.14
29	202.8		1.242	.546	190	.1335	11,563	424	447	307	2788	309	1.584	192	1744	193	6.68	58.43	6.97
30	183.3		1.258	.565	190	.1352	11,500	421	447	369	3308	371	1.618	248	2224	249	6.87	57.23	7.14
31	202.8		1.237	.542	180	.1327	11,188	424	447	274	2499	275	1.491	163	1467	164	6.52	55.31	6.81

[redacted]

2470

SIMULATED-FLIGHT CONDITIONS WITH MIXER VANES INSTALLED - Concluded

Engine total-temperature ratio $\frac{T_5}{T_2}$	Fuel flow, (lb/hr) Altitude W_f	Corrected $\frac{W_f}{\delta_T \sqrt{\theta_T}}$	Adjusted $\frac{W_f}{\delta_{adj} \sqrt{\theta_{adj}}}$	Turbine-outlet total pressure P_5 $\left(\frac{lb}{sq\ ft\ abs.}\right)$	Specific fuel consumption $\frac{lb/hr}{lb}$ Altitude $\frac{W_f}{F_n}$	Corrected $\frac{W_f}{F_n \sqrt{\theta_T}}$	Adjusted $\frac{W_f}{F_n \sqrt{\theta_{adj}}}$	Exhaust gas total temperature, (°R) Altitude T_8	Corrected $\frac{T_8}{\theta_T}$	Adjusted $\frac{T_8}{\theta_{adj}}$	Corrected engine speed $\frac{N}{\sqrt{\theta_T}}$ (rpm)	Adjusted engine speed $\frac{N}{\sqrt{\theta_{adj}}}$ (rpm)	Run
(e) Miscellaneous points, exhaust-nozzle area given.													
3.488	1293	3520	1276	1613	1.278	1.385	1.253	1578	1800	1518	11,508	10,568	1
3.146	1134	3086	1110	1485	1.330	1.426	1.306	1425	1634	1374	11,353	10,406	2
3.316	1034	2828	1016	1366	1.544	1.652	1.516	1489	1721	1444	10,883	9,803	3
3.785	1246	4677	1225	1338	1.444	1.551	1.433	1707	1943	1677	13,010	12,018	4
3.827	1206	4594	1180	1320	1.470	1.578	1.455	1730	1965	1691	12,343	11,395	5
3.878	1112	4165	1104	1267	1.500	1.607	1.488	1670	1984	1638	11,960	11,078	6
3.488	883	3301	867	1056	1.786	1.894	1.752	1573	1909	1549	11,401	10,545	7
3.869	1017	4900	980	1049	1.431	1.642	1.378	1746	2018	1612	12,793	11,430	8
3.636	925	4443	885	999	1.421	1.626	1.363	1636	1886	1507	12,646	11,297	9
3.751	970	4642	932	1035	1.425	1.532	1.371	1688	1946	1558	12,593	11,262	10
3.780	960	4671	934	1021	1.426	1.532	1.370	1701	1961	1570	12,419	11,106	11
3.370	800	5823	765	911	1.543	1.660	1.486	1515	1749	1400	11,758	10,518	12
3.301	717	3407	683	805	1.793	1.920	1.718	1492	1711	1370	11,367	10,163	13
3.285	622	4296	616	599	1.781	1.908	1.708	1485	1705	1364	11,888	10,636	14
3.134	597	4232	602	569	1.848	1.988	1.777	1404	1626	1299	11,863	10,602	15
2.821	555	3821	552	499	2.605	2.789	2.496	1275	1462	1171	11,219	10,037	16
2.907	527	3586	517	470	3.121	3.349	2.994	1306	1506	1208	10,405	9,306	17
2.976	514	3558	515	443	3.407	3.642	3.265	1345	1543	1238	9,974	8,935	18
3.367	598	4714	584	545	1.796	1.940	1.750	1495	1748	1484	12,810	11,805	19
3.361	598	4513	579	564	1.829	1.963	1.817	1525	1755	1502	12,071	11,168	20
2.878	540	4064	536	481	2.203	2.367	2.200	1294	1492	1286	11,546	10,722	21
2.879	528	4000	516	434	2.809	3.027	2.803	1306	1517	1302	11,174	10,348	22
2.926	486	3627	476	400	3.767	4.059	3.744	1211	1389	1196	10,175	9,440	23
3.389	501	4896	487	4.14	2.027	2.174	2.031	1532	1757	1407	13,621	12,097	24
3.198	482	4644	455	394	2.106	2.262	2.359	1436	1660	1340	13,464	12,087	25
3.757	550	5549	528	464	1.718	1.841	1.650	1698	1948	1563	13,321	11,933	26
3.051	476	4881	459	380	2.283	2.433	2.176	1376	1584	1269	13,010	11,646	27
3.557	527	5109	510	450	1.763	1.909	1.713	1604	1846	1494	12,944	11,600	28
2.873	470	4586	455	369	2.446	2.630	2.358	1290	1491	1198	12,430	11,153	29
3.272	502	4842	487	429	2.025	2.177	1.856	1466	1698	1369	12,374	11,111	30
2.755	460	4515	459	346	2.825	3.037	2.718	1237	1430	1146	12,027	10,772	31

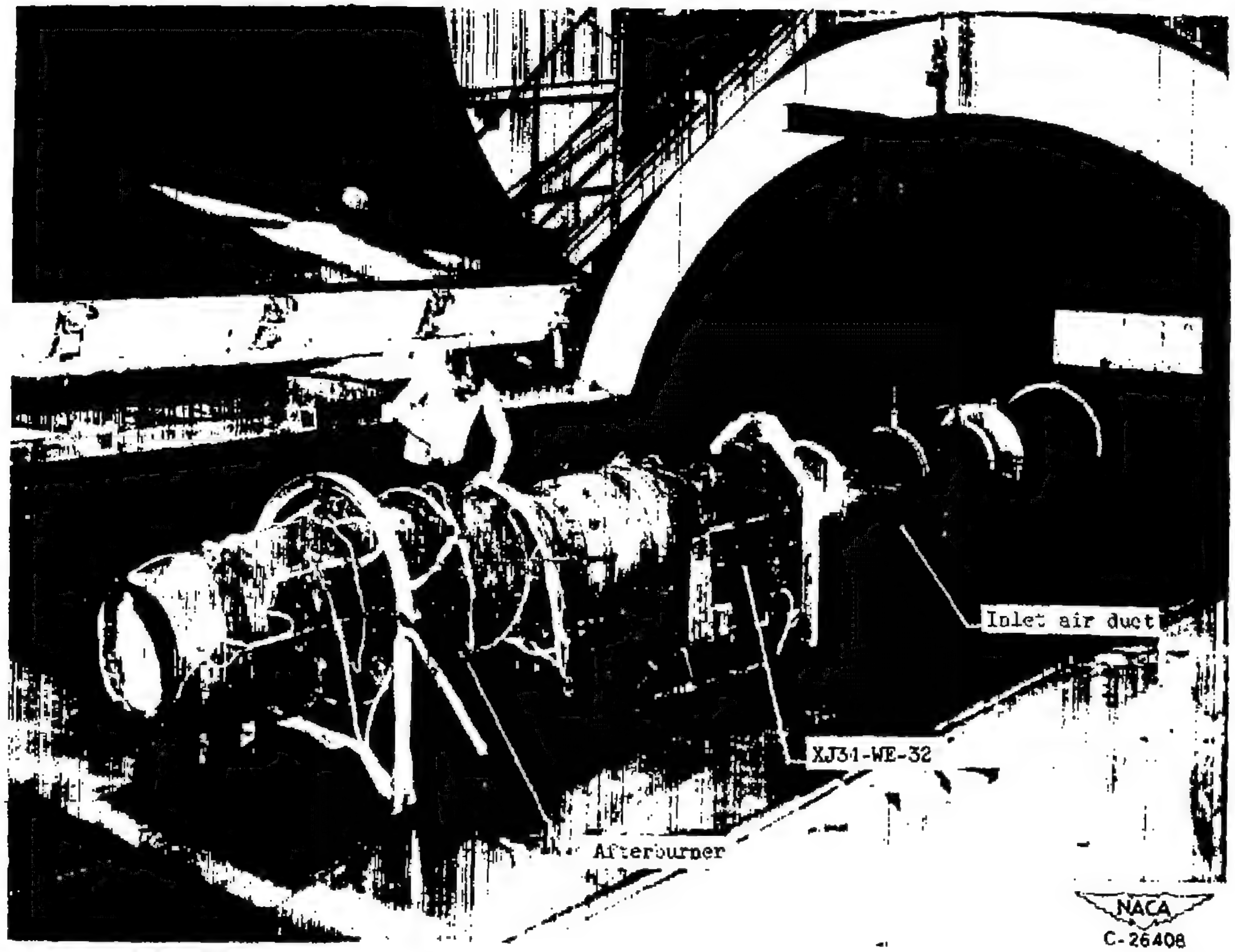


Figure 1. - Installation of XJ34-WE-32 in altitude wind tunnel.

Station	Total pressure tubes	Static pressure tubes	Thermo-couples
1	17	5	9
2	16	10	8
3	15	3	3
4	5	--	--
5	21	6	36
7	30	20	30
8	26	11	16

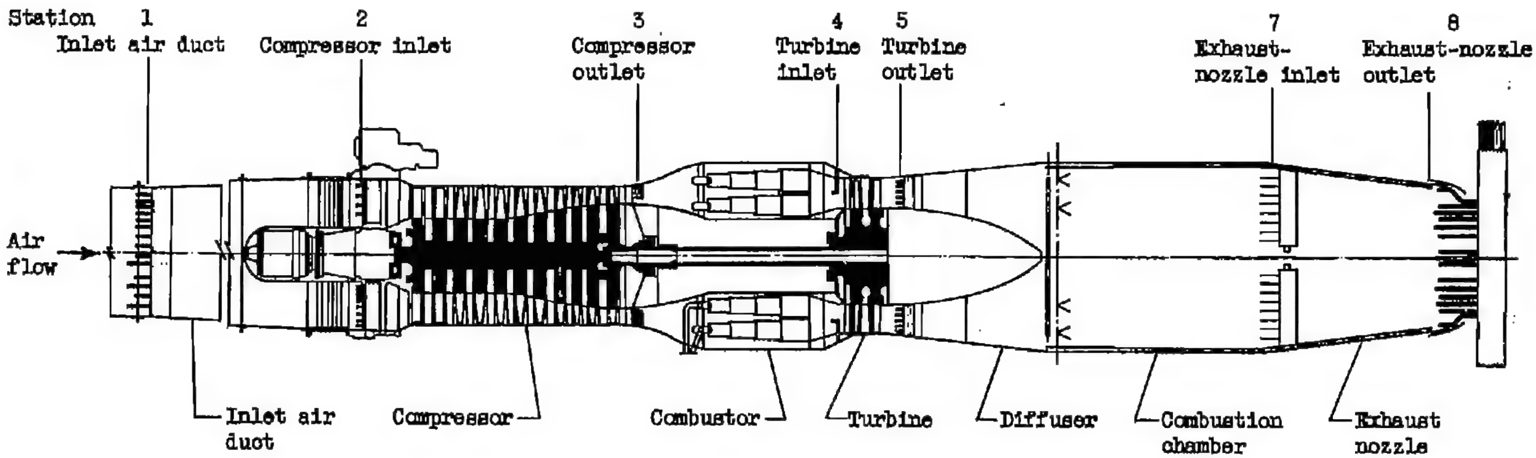


Figure 2. - Cross section of engine showing location of instrumentation.

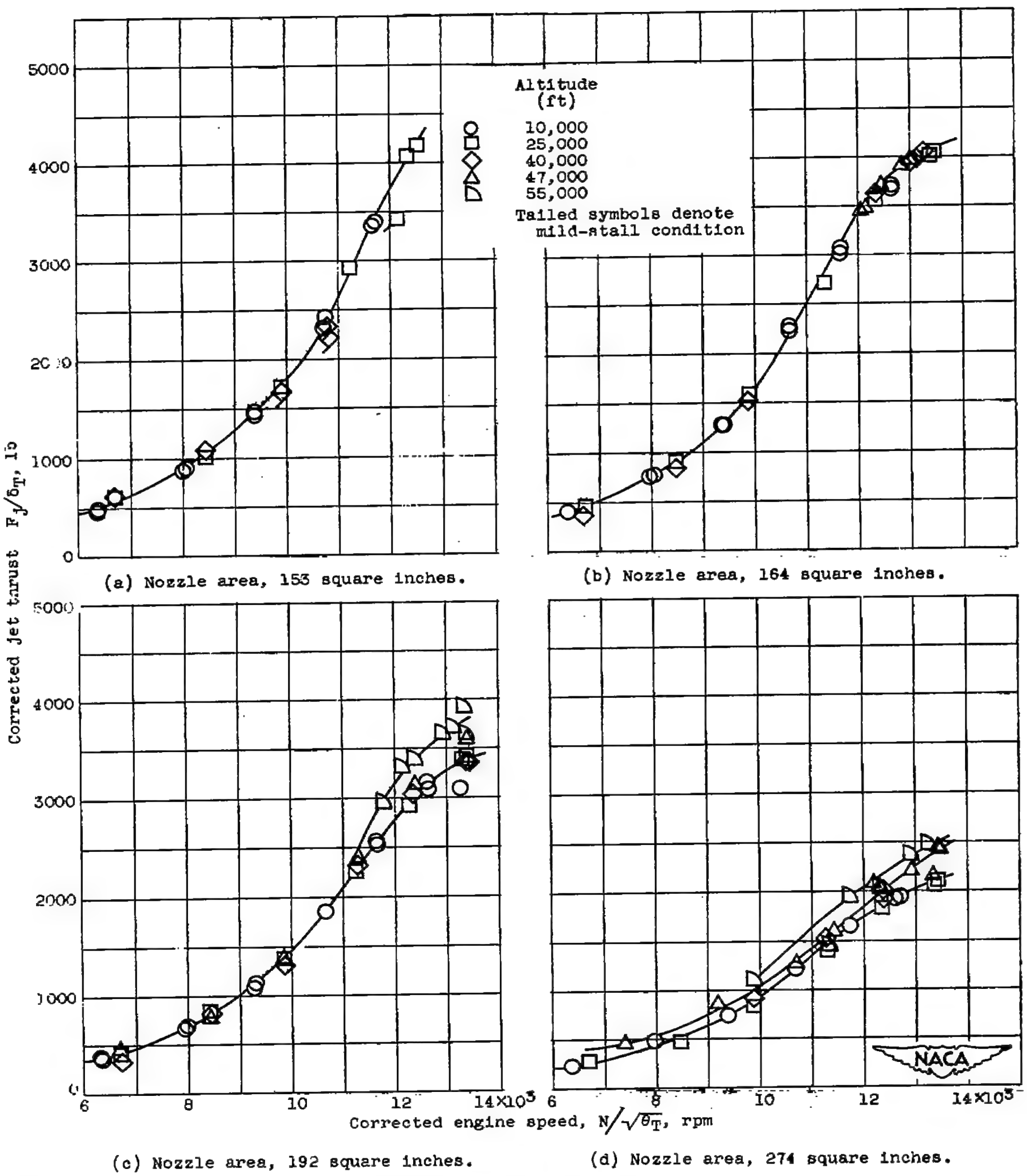
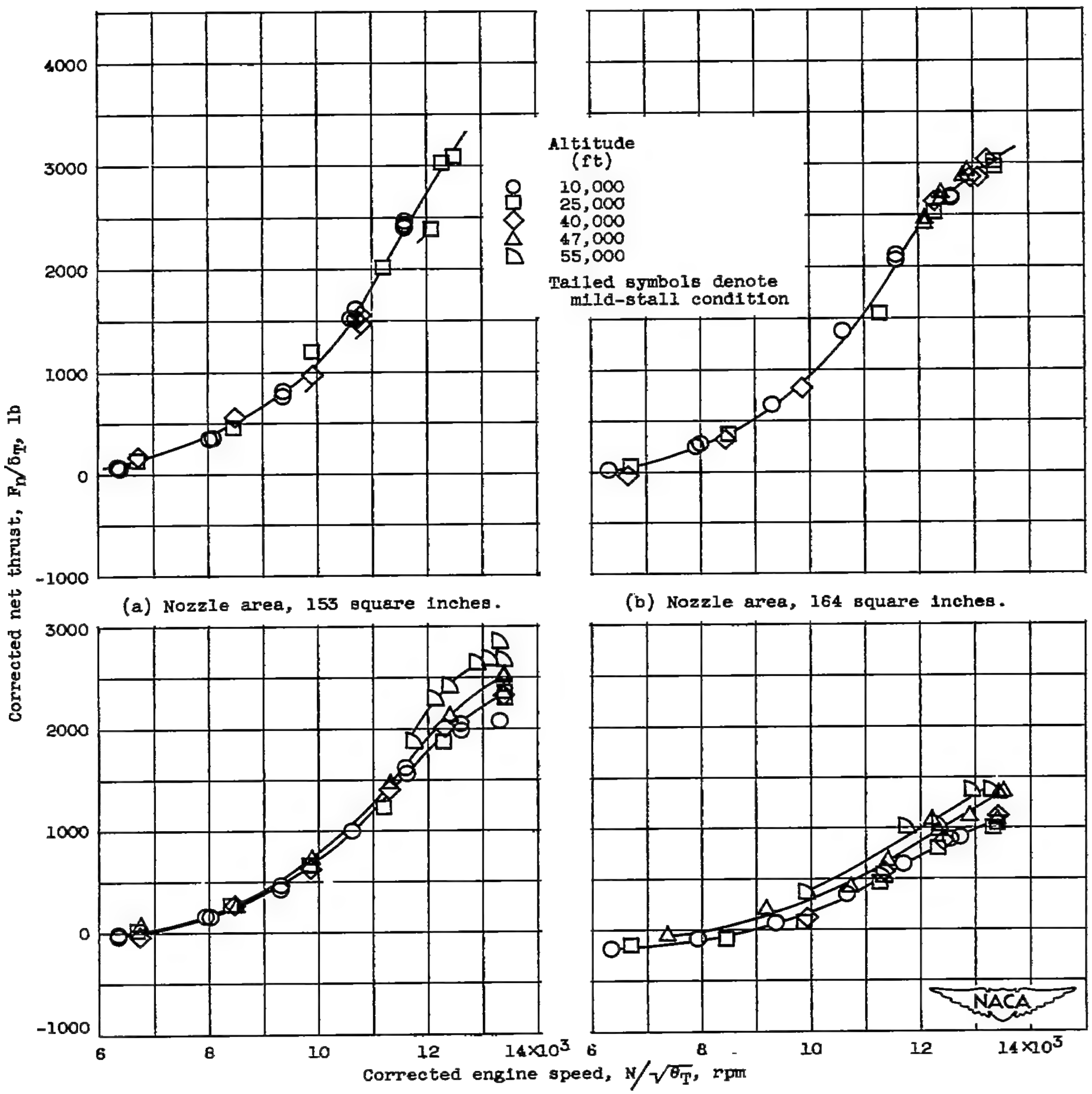


Figure 3. - Effect of altitude on variation of corrected jet thrust with corrected engine speed at flight Mach number of 0.528.

2470

2470



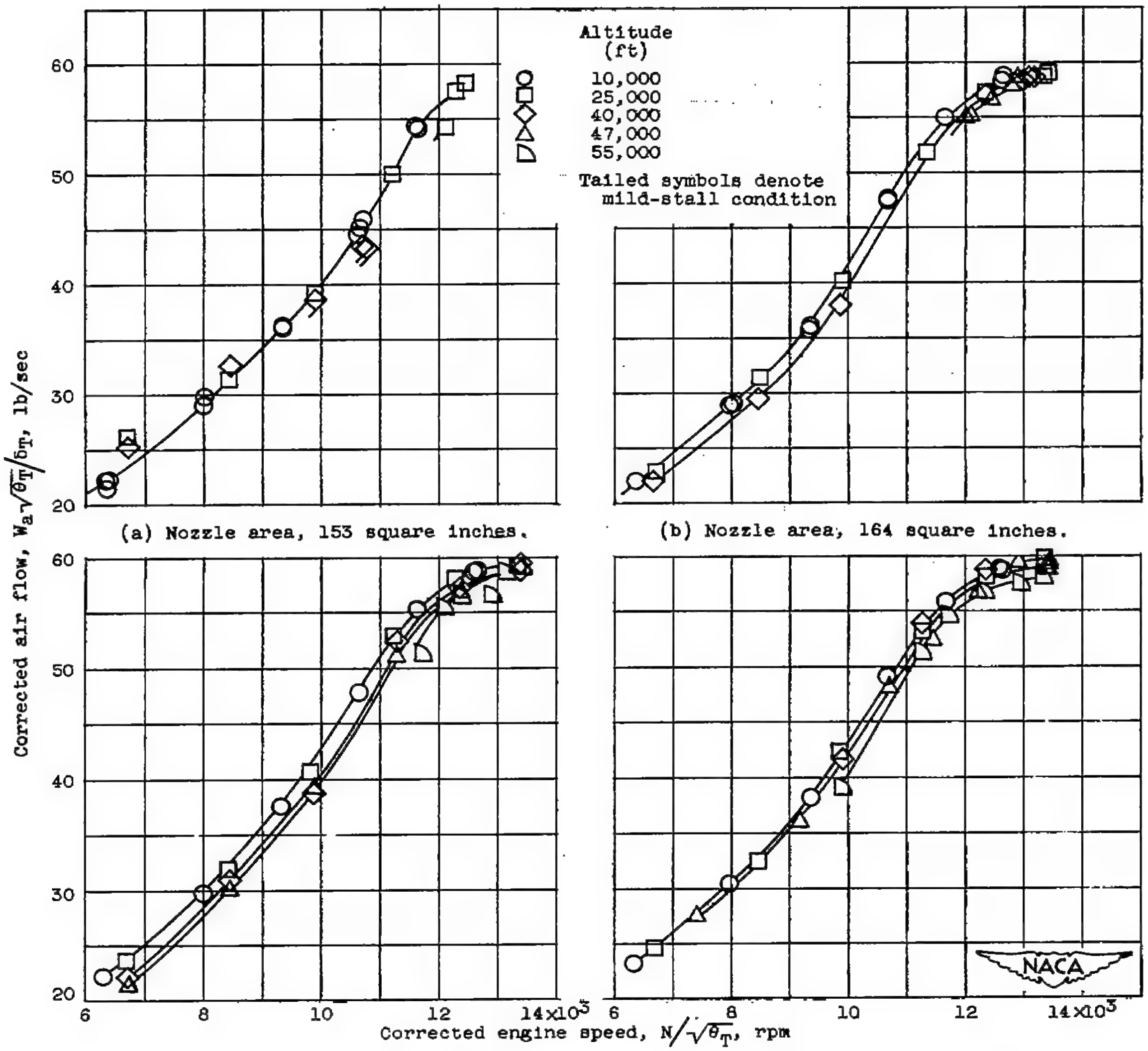
(a) Nozzle area, 153 square inches.

(b) Nozzle area, 164 square inches.

(c) Nozzle area, 192 square inches.

(d) Nozzle area, 274 square inches.

Figure 4. - Effect of altitude on variation of corrected net thrust with corrected engine speed at flight Mach number of 0.528.



(c) Nozzle area, 192 square inches. (d) Nozzle area, 274 square inches.

Figure 5. - Effect of altitude on variation of corrected air flow with corrected engine speed at flight Mach number of 0.528.

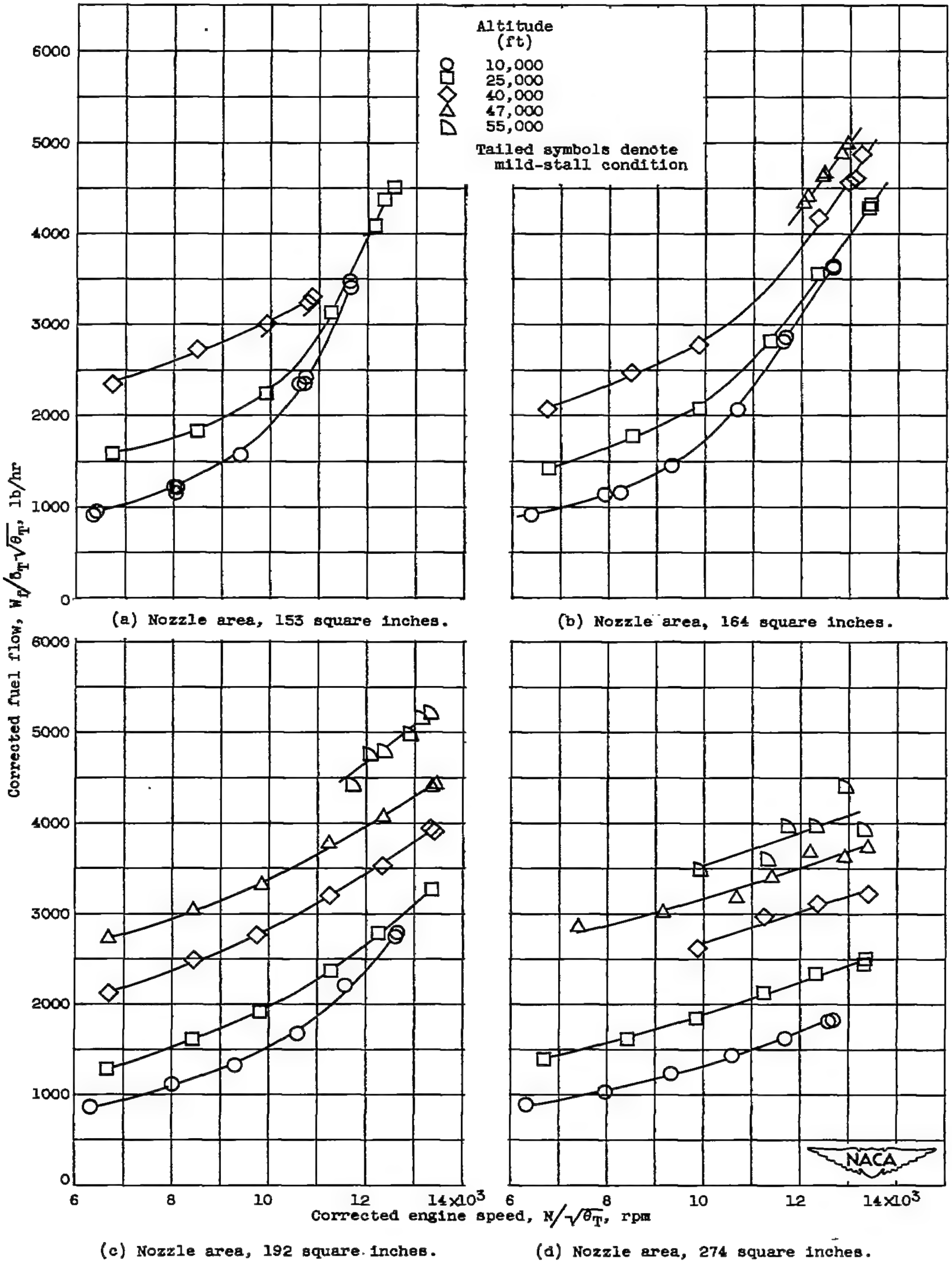
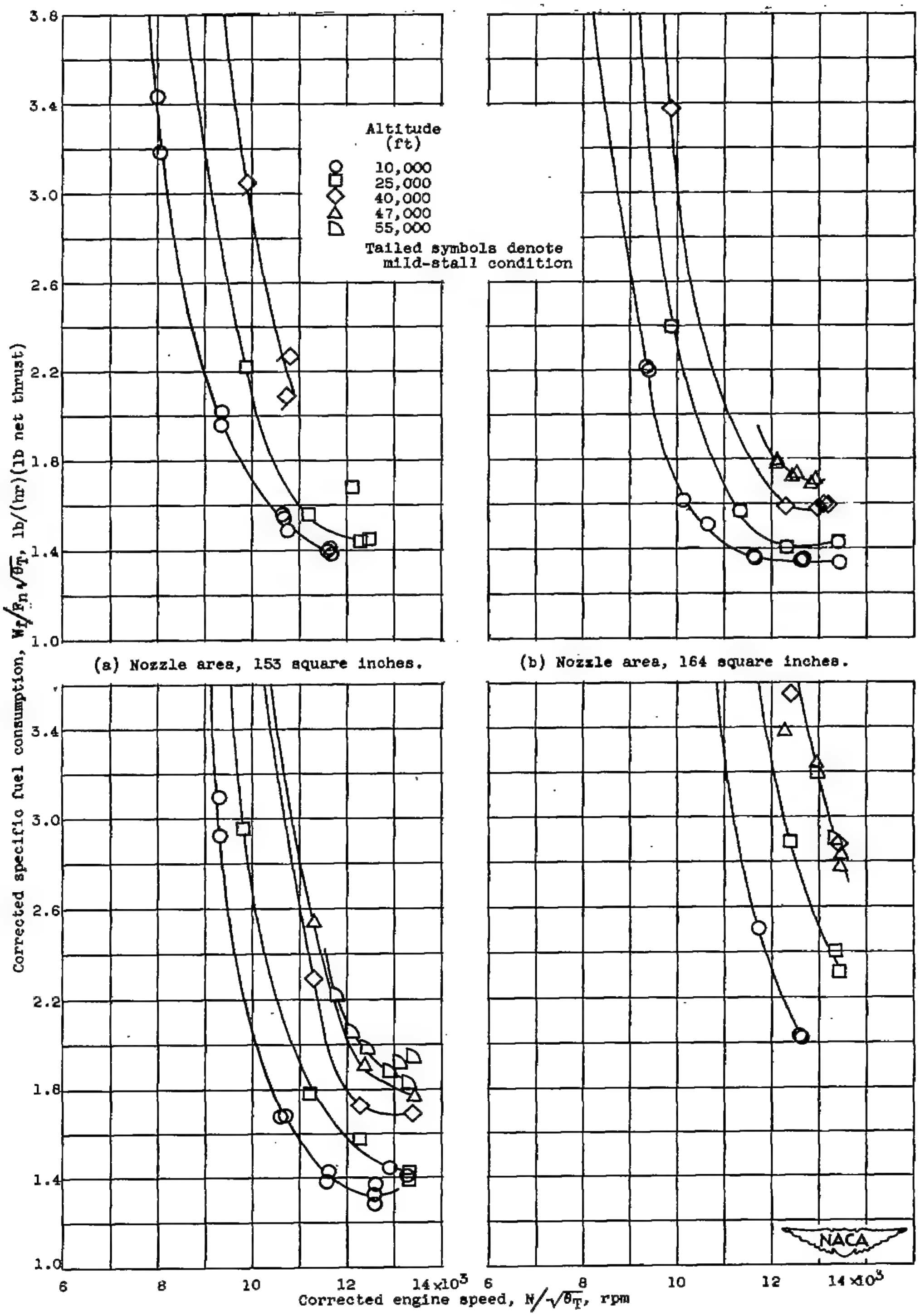


Figure 6. - Effect of altitude on variation of corrected fuel flow with corrected engine speed at flight Mach number of 0.528.

[redacted]



(a) Nozzle area, 153 square inches.

(b) Nozzle area, 164 square inches.

(c) Nozzle area, 192 square inches.

(d) Nozzle area 274 square inches.

Figure 7. - Effect of altitude on variation of corrected specific fuel consumption with corrected engine speed at flight Mach number of 0.528.

2470

[redacted]

2470

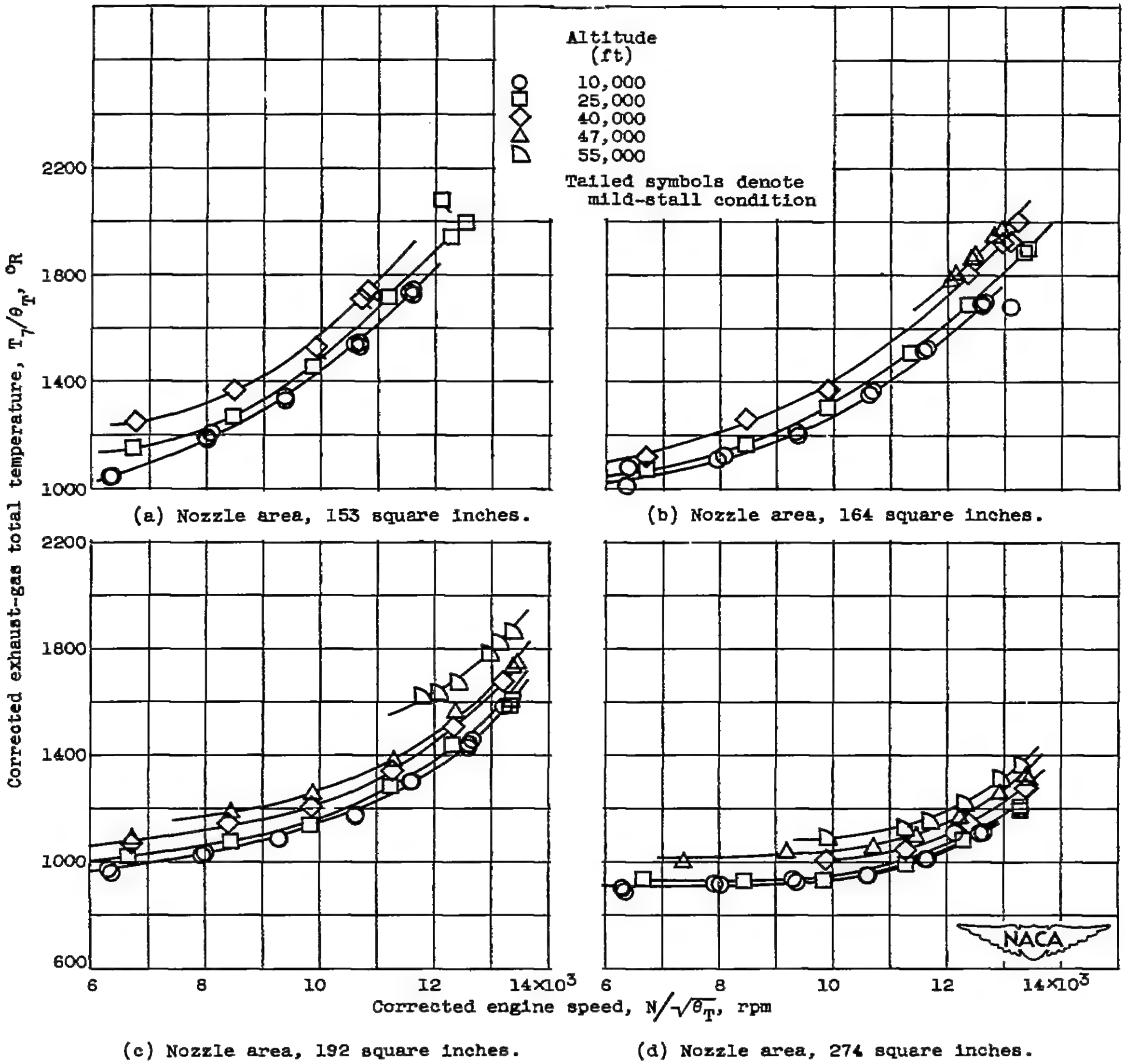


Figure 8. - Effect of altitude on variation of corrected exhaust-gas total temperature with corrected engine speed at flight Mach number of 0.528.

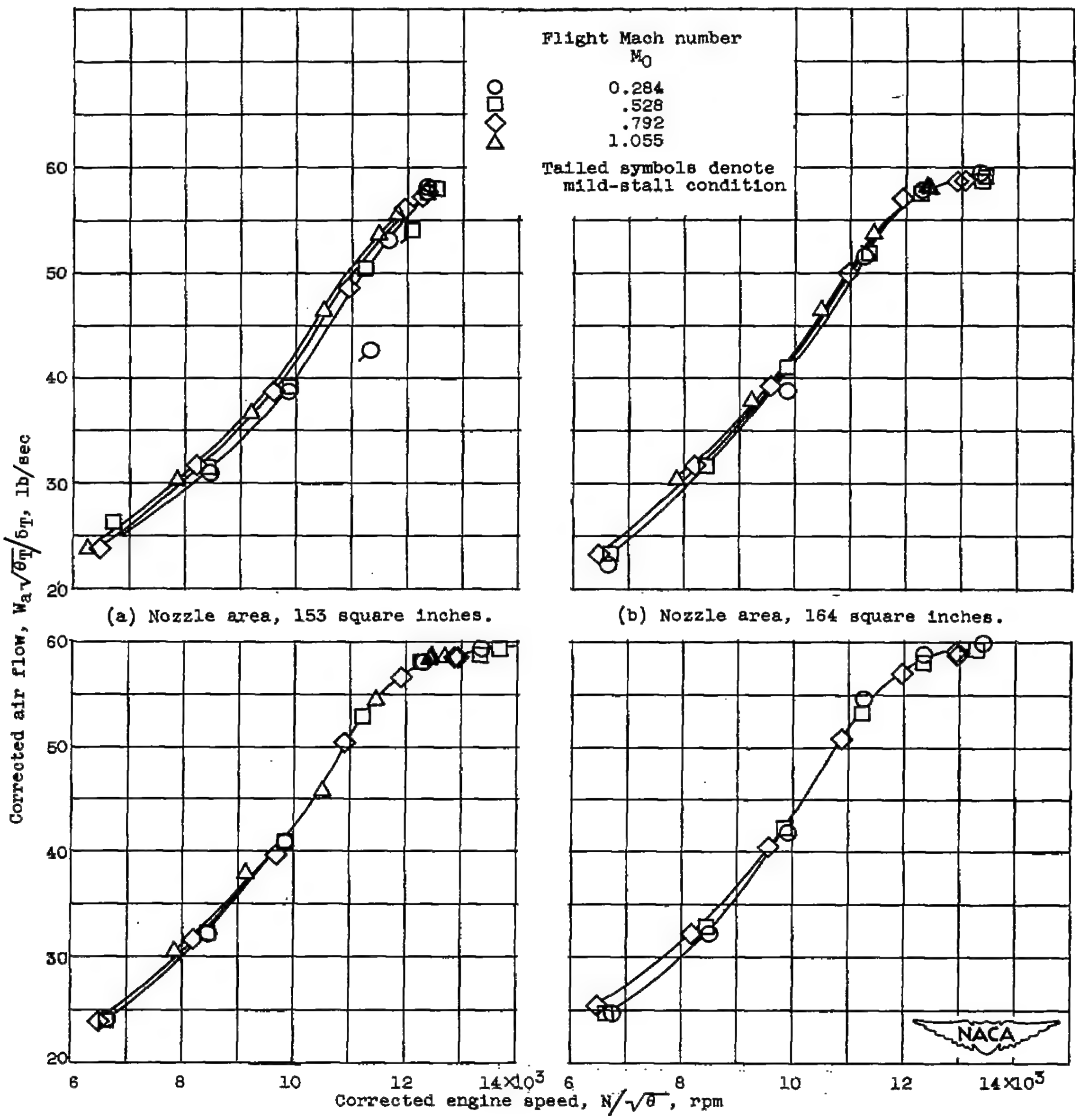
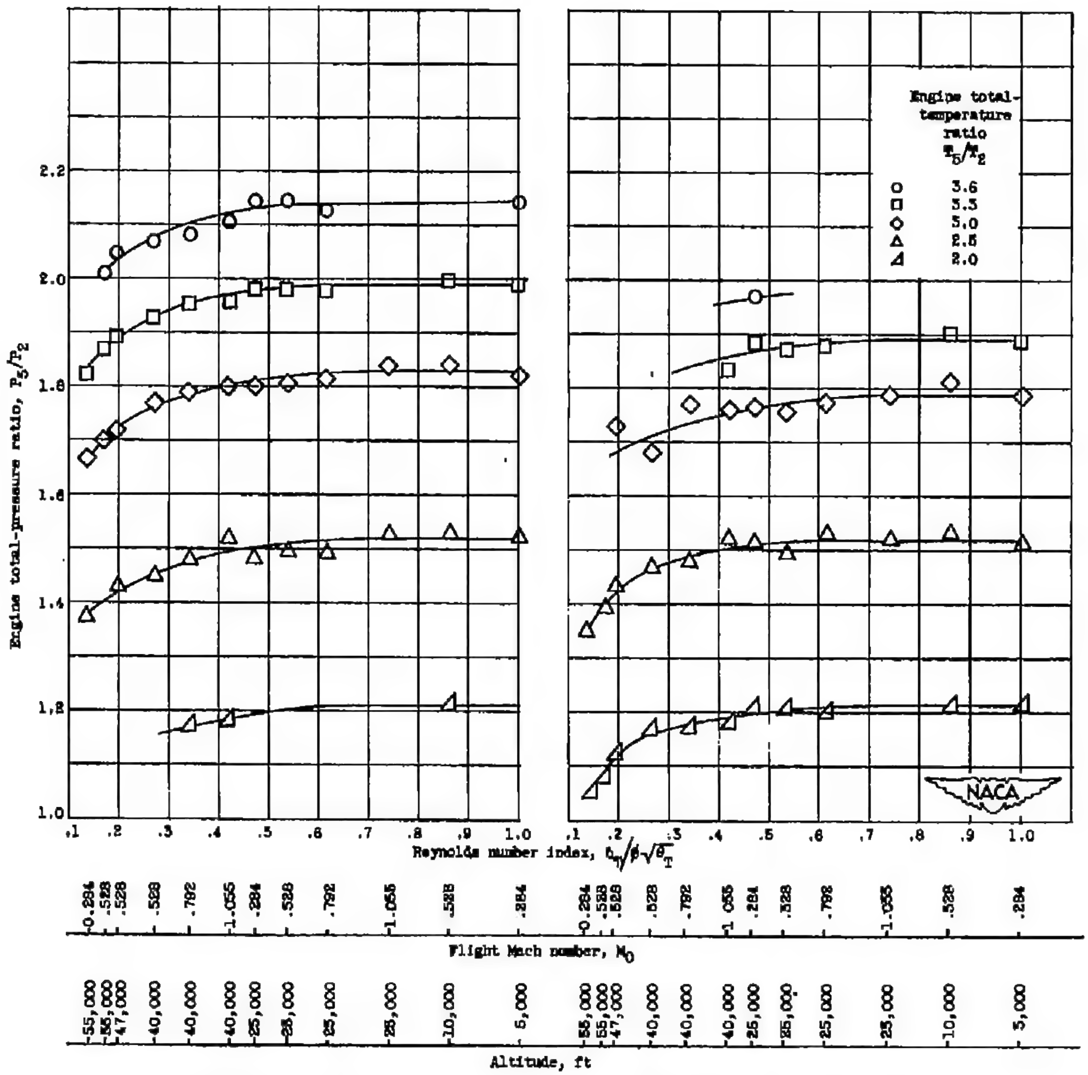


Figure 9. - Effect of flight Mach number on variation of corrected air flow with corrected engine speed at altitude of 25,000 feet.

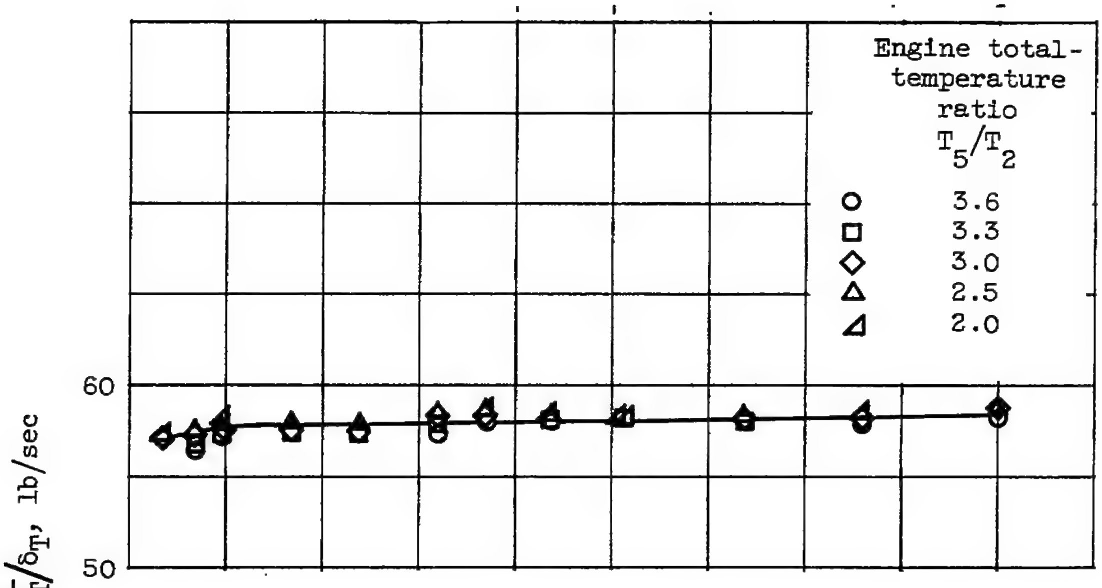


(a) Corrected engine speed, 12,500 rpm.

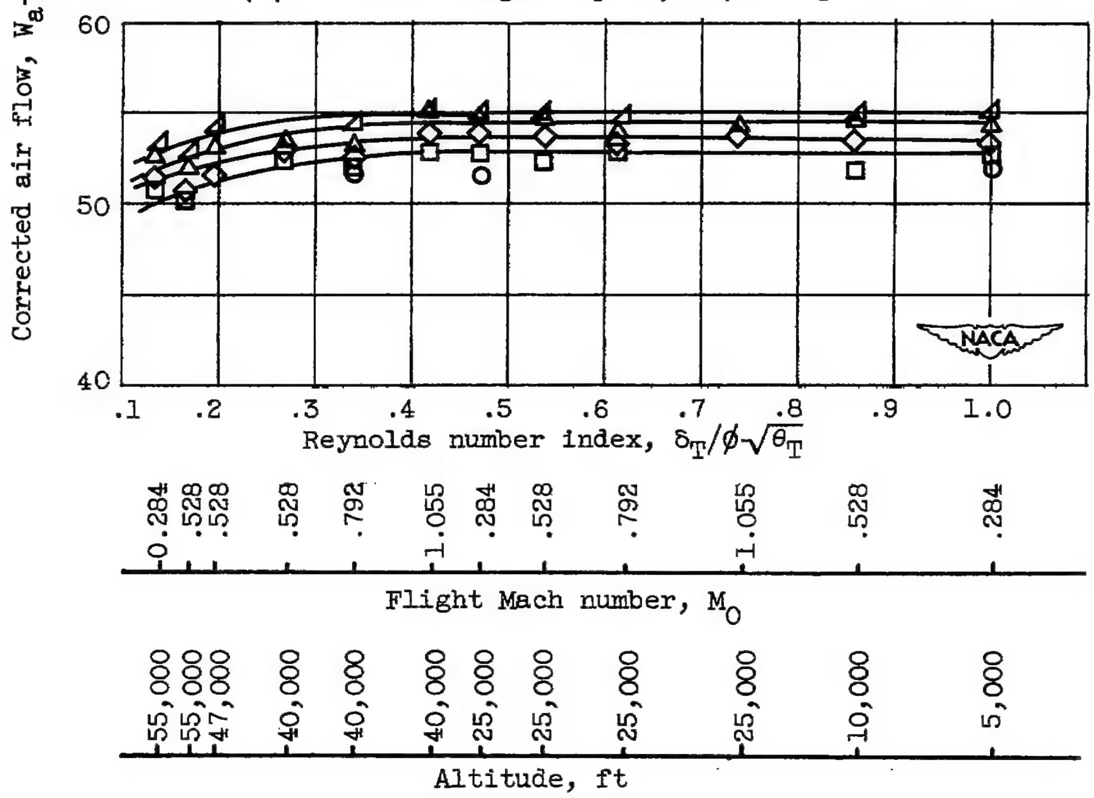
(b) Corrected engine speed, 11,500 rpm.

Figure 10. - Variation of engine total-pressure ratio with Reynolds number index for various engine total-temperature ratios.

2470



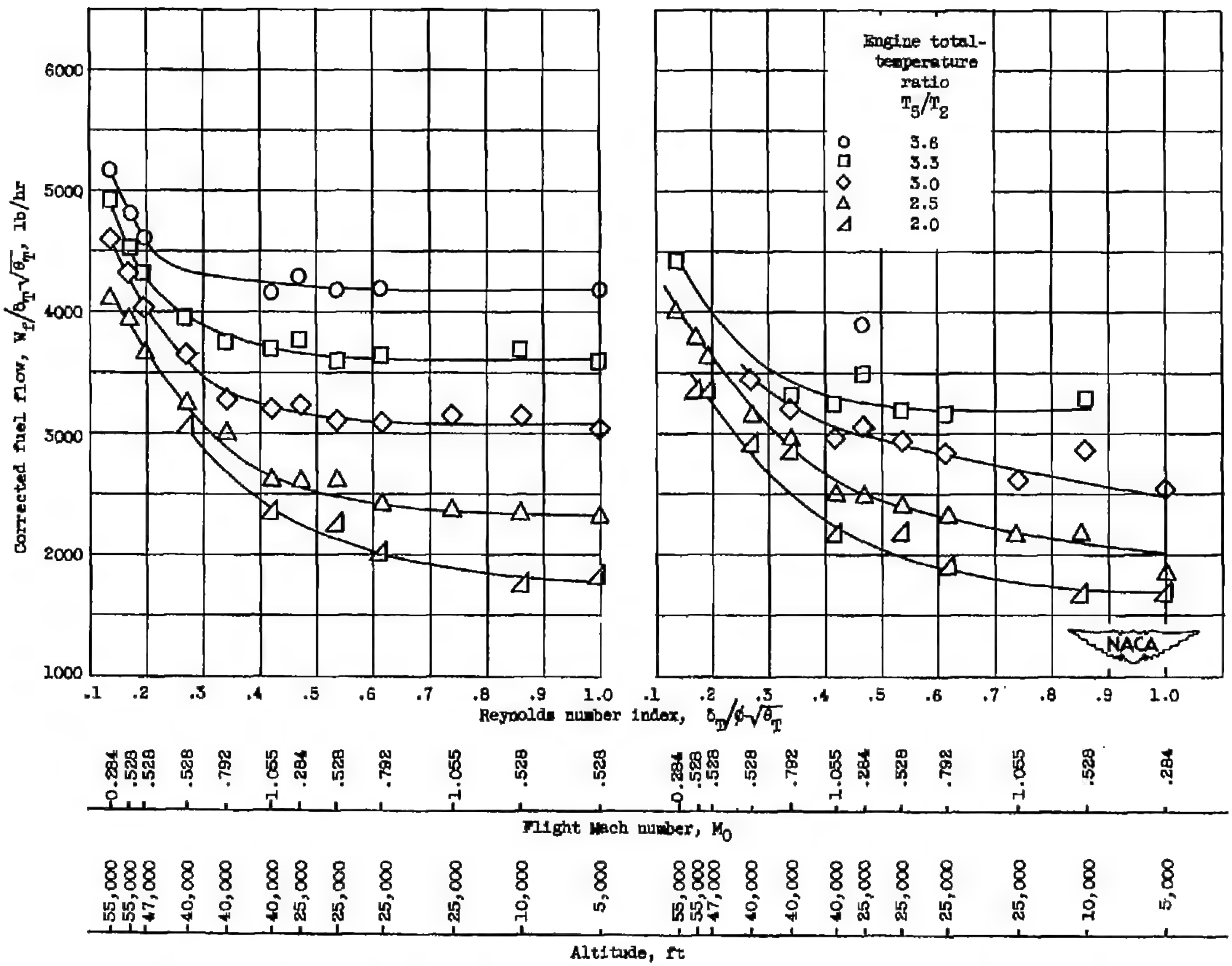
(a) Corrected engine speed, 12,500 rpm.



(b) Corrected engine speed, 11,500 rpm.

Figure 11. - Variation of corrected air flow with Reynolds number index for various engine temperature ratios.

[redacted]



(a) Corrected engine speed, 12,500 rpm.

(b) Corrected engine speed, 11,500 rpm.

Figure 12. - Variation of corrected fuel flow with Reynolds number index for various engine total-temperature ratios.

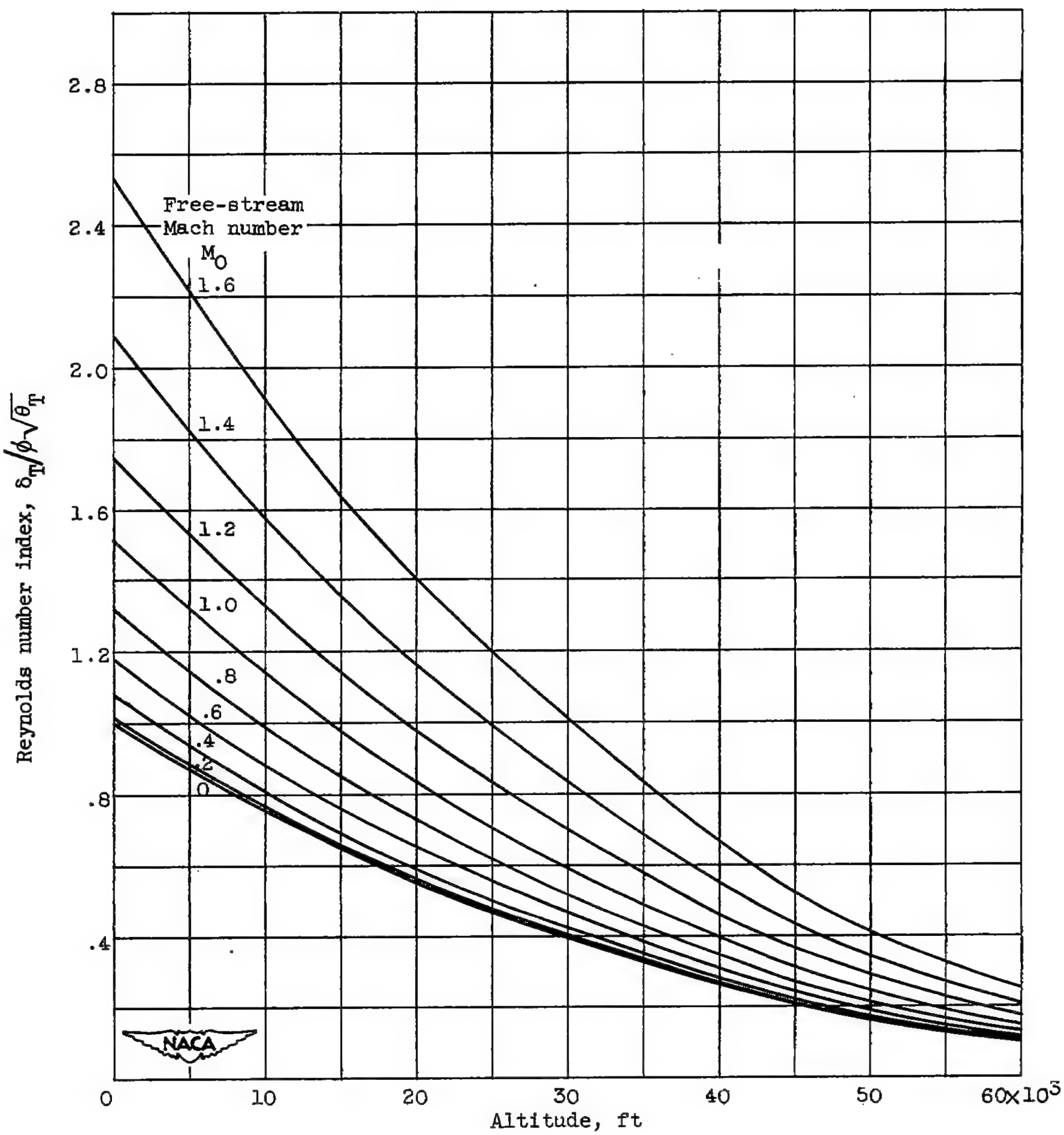
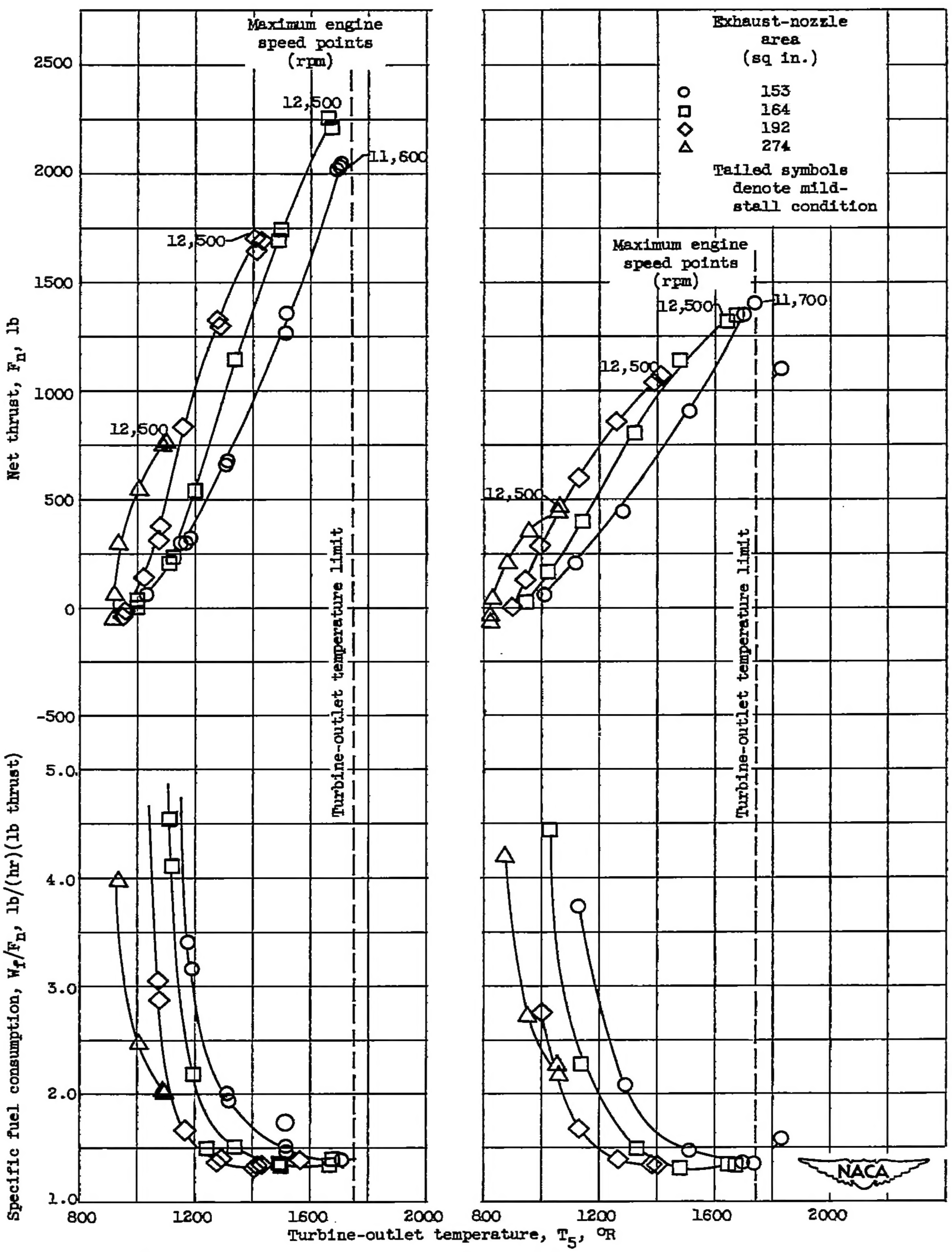


Figure 13. - Chart for evaluating Reynolds number index at altitude for flight Mach numbers varying from 0 to 1.6.

2470

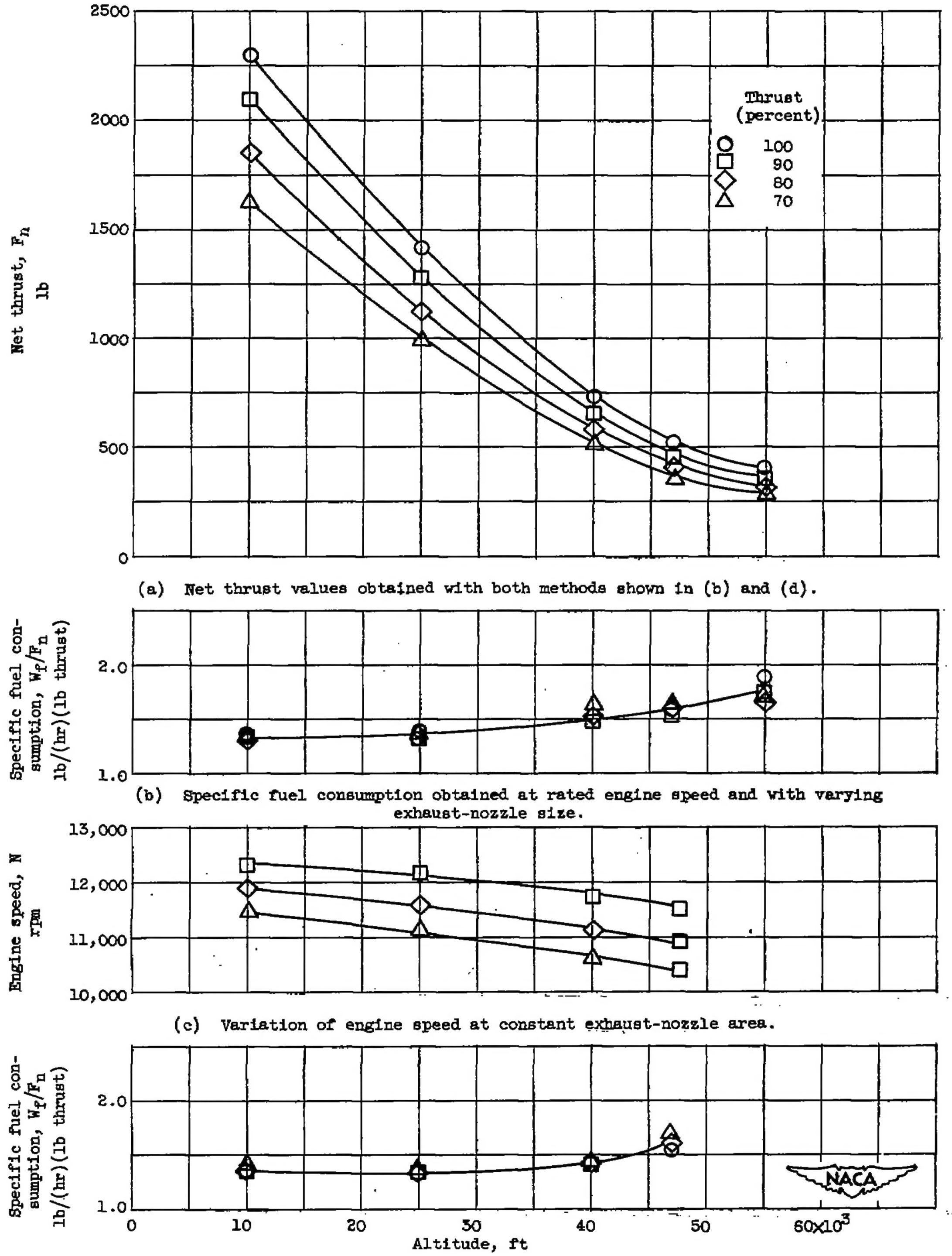
2470



(a) Altitude, 10,000 feet. (b) Altitude, 25,000 feet.

Figure 14. - Variation of specific fuel consumption and net thrust with turbine-outlet temperature for four nozzle areas at flight Mach number of 0.528.

[redacted]



(a) Net thrust values obtained with both methods shown in (b) and (d).

(b) Specific fuel consumption obtained at rated engine speed and with varying exhaust-nozzle size.

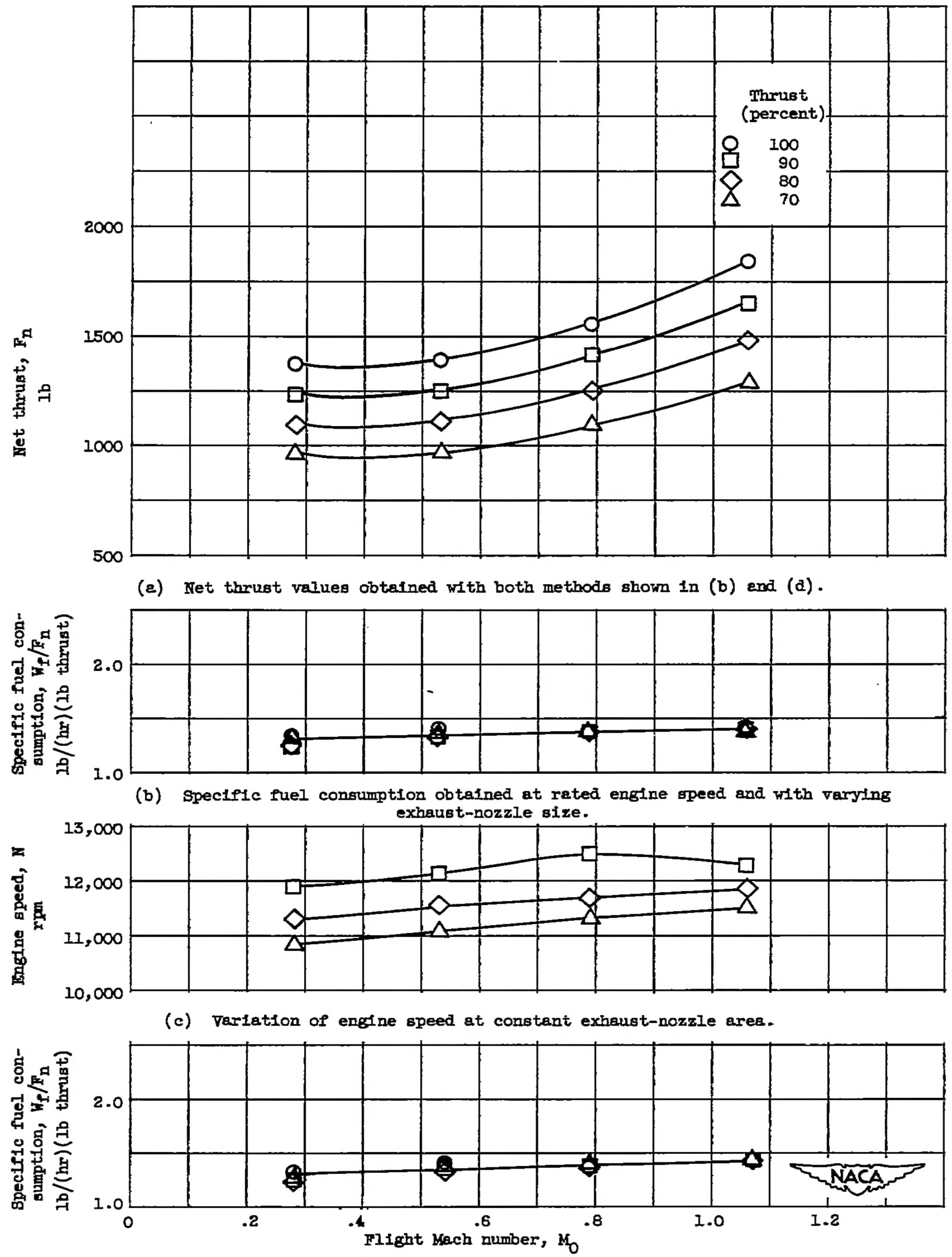
(c) Variation of engine speed at constant exhaust-nozzle area.

(d) Variation of specific fuel consumption at constant exhaust-nozzle area.

Figure 15. - Variation of engine variables with altitude at flight Mach number of 0.528.

[redacted]

2470



(a) Net thrust values obtained with both methods shown in (b) and (d).

(b) Specific fuel consumption obtained at rated engine speed and with varying exhaust-nozzle size.

(c) Variation of engine speed at constant exhaust-nozzle area.

(d) Variation of specific fuel consumption at constant exhaust-nozzle area.

Figure 16. - Variation of engine variables with flight Mach number at altitude of 25,000 feet.

[redacted]

NACA-Langley - 5-29-53 - 400

SECURITY INFORMATION

NASA Technical Library
3 1176 01434 9816

[redacted]